

ATM Management Interface (AMI) Manual

MANU0021-04 - Rev. A - 5/14/98

Software Version 5.2.x

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WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void this user's authority to operate this equipment.

NOTE: The ASX-200WG, the ASX-200BX, the ASX-1000, and the *ForeRunnerLE* 155 have been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of the equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

DOC CLASS A NOTICE

This digital apparatus does not exceed Class A limits for radio noise emission for a digital device as set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numerique n'emet pas de bruits radioelectriques depassant les limites applicables aux appareils numeriques de la class A prescrites dans le reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

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FCC REQUIREMENTS (Notice to Users of DS1 Service)

The following instructions are provided to ensure compliance with the Federal Communications Commission (FCC) Rules, Part 68.

- This device must only be connected to the DS1 network connected behind an FCC Part 68 registered channel service unit. Direct connection is not allowed.
- (2) Before connecting your unit, you must inform the telephone company of the following information:

Port ID	REN/SOC	FIC	USOC
NM-6/DS1C	6.0N	04DU9-BN,	RJ48C
NM-2/DS1C		04DU9-DN,	
NM-8/DS1D		04DU9-1ZN, and	
NM-4/DS1D		04DU9-1SN	

- (3) If the unit appears to be malfunctioning, it should be disconnected from the telephone lines until you learn if your equipment or the telephone line is the source of the trouble. If your equipment needs repair, it should not be reconnected until it is repaired.
- (4) If the telephone company finds that this equipment is exceeding tolerable parameters, the telephone company can temporarily disconnect service, although they will attempt to give you advance notice if possible.
- (5) Under the FCC Rules, no customer is authorized to repair this equipment. This restriction applies regardless of whether the equipment is in or out of warranty.
- (6) If the telephone company alters their equipment in a manner that will affect use of this device, they must give you advance warning so as to give you the opportunity for uninterrupted service. You will be advised of your right to file a complaint with the FCC.

CANADIAN IC CS-03 COMPLIANCE STATEMENT

<u>NOTICE</u>: The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Industry Canada label does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local tele-communications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

<u>Caution</u>: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

F1 AND E3 NOTICE

The E1 (NM-6/E1C, NM-2/E1C, NM-8/E1D, and NM-4/E1D) and E3 (NM-4/E3C, NM-2/E3C, NM-4/E3D, and NM-2/E3D) network modules that are described in this manual are approved for use in FORE Systems' host systems providing that the instructions below are strictly observed. Failure to follow these instructions invalidates the approval.

Pan European Approval - CE Marking

Pan European approval of the E1 network module was issued by BABT following assessment against CTR12. This means that it can be connected to ONP and unstructured PTO-provided private circuits with 120 Ω interfaces in all European countries, according to Telecommunications Terminal Equipment (TTE) Directive 91/263/EEC. Thus, the following CE mark applies:

C€168.X

The E1 and E3 network modules conform to safety standard EN60950: 1992 following the provisions of Low Voltage Product Safety Directive 73/23/EEC and CE Marking Directive 93/68/EEC, and can be marked accordingly with the CE symbol.

The E1 and E3 network modules conform to EN55022: 1994 and EN50082-1: 1992 following the provisions of the EMC Directive 89/336/EEC, and can be marked accordingly with the CE symbol.

National Approvals

UK

Network Module	Connects to	Approval Number
E1	PTO-provided private circuits with 75 Ω interfaces	AA60953
E3	PTO-provided private circuits with 75 Ω interfaces	NS/4387/1/T/605954
CEM E1	PTO-provided private circuits with 75 Ω or 120 Ω unstructured interfaces	AA607478

Required User Guide Statements - UK Installation

The network modules are designed for use only with FORE Systems ATM Switches. Use of the network modules in any product not listed in this manual may result in a hazard and will invalidate the regulatory approval. The network modules must be installed in accordance with the installation instructions provided.

The following table shows the available ports and their safety status:

Ports	Safety Status
E1 and E3 Ports	TNV operating at SELV
Bus Connector	SELV

CE NOTICE

Marking by the symbol **CE** indicates compliance of this system to the EMC (Electromagnetic Compatibility) directive of the European Community and compliance to the Low Voltage (Safety) Directive. Such marking is indicative that this system meets or exceeds the following technical standards:

- EN 55022 "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment."
- EN 50082-1 "Electromagnetic compatibility Generic immunity standard Part 1: Residential, commercial, and light industry."
- IEC 1000-4-2 "Electromagnetic compatibility for industrial-process measurement and control equipment Part 2: Electrostatic discharge requirements."
- IEC 1000-4-3 "Electromagnetic compatibility for industrial-process measurement and control equipment Part 3: Radiate electromagnetic field requirements."
- IEC 1000-4-4 "Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Electrical fast transient/burst requirements."

SAFETY CERTIFICATIONS

ETL certified to meet Information Technology Equipment safety standards UL 1950, CSA 22.2 No. 950, and EN 60950.

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Acronyms

Glossary

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Preface

This manual provides the technical information needed to configure the ATM Management Interface (AMI) for the *ForeRunner*TM family of ATM Switches, *ForeRunnerLE* Switches, and TNX ATM Switches. This document was created for users with various levels of experience. If you have any questions or problems, please contact FORE Systems' Technical Support.

Chapter Summaries

Chapter 1 - AMI Overview - Provides an overview of AMI and contains a text and graphical description of the root level AMI commands.

Chapter 2 - AMI Display Commands - Contains a text and graphical description of the display level AMI commands.

Chapter 3 - AMI Operation Commands - Contains a text and graphical description of the operation level AMI commands.

Chapter 4 - AMI Statistics Commands - Contains a text and graphical description of the statistics level AMI commands.

Related Manuals

AMI Configuration Command Reference Manual, Part 1 - Describes the configuration level AMI commands and menus from configuration alarms> to configuration nsap>.

AMI Configuration Command Reference Manual, Part 2 - Describes the configuration level AMI commands and menus from configuration port> to configuration vpt>.

ATM Switch Diagnostics and Troubleshooting Manual - Describes the debug level AMI commands and menus. Also, describes error messages, loopbacks, SCP diagnostics, and ATM Forum PNNI debugging information.

Technical Support

In the U.S.A., customers can reach FORE Systems' Technical Assistance Center (TAC) using any one of the following methods:

1. Select the "Support" link from FORE's World Wide Web page:

http://www.fore.com/

2. Send questions, via e-mail, to:

support@fore.com

3. Telephone questions to "support" at:

800-671-FORE (3673) or 724-742-6999

4. FAX questions to "support" at:

724-742-7900

Technical support for customers outside the United States should be handled through the local distributor or via telephone at the following number:

+1 724-742-6999

No matter which method is used to reach FORE Support, customers should be ready to provide the following:

- A support contract ID number
- The serial number of each product in question
- All relevant information describing the problem or question

Typographical Styles

Throughout this manual, all specific commands meant to be entered by the user appear on a separate line in bold typeface. In addition, use of the Enter or Return key is represented as **ENTER>**. The following example demonstrates this convention:

cd /usr <ENTER>

File names that appear within the text of this manual are represented in the following style: "...the fore_install program installs this distribution."

Command names that appear within the text of this manual are represented in the following style: "...using the flush-cache command clears the bridge cache."

Subsystem names that appear within the text of this manual are represented in the following style: "...to access the bridge subsystem..."

Parameter names that appear within the text of this manual are represented in the following style: "...using <seg-list> allows you to specify the segments for which you want to display the specified bridge statistics."

Any messages that appear on the screen during software installation and network interface administration are shown in Courier font to distinguish them from the rest of the text as follows:

.... Are all four conditions true?

Important Information Indicators

To call your attention to safety and otherwise important information that must be reviewed to ensure correct and complete installation, as well as to avoid damage to the FORE Systems product or to your system, FORE Systems utilizes the following *WARNING/CAUTION/NOTE* indicators.

WARNING statements contain information that is critical to the safety of the operator and/or the system. Do not proceed beyond a **WARNING** statement until the indicated conditions are fully understood or met. This information could prevent serious injury to the operator, damage to the FORE Systems product, the system, or currently loaded software, and is indicated as follows:

WARNING!



Hazardous voltages are present. To reduce the risk of electrical shock and danger to personal health, follow the instructions carefully.

CAUTION statements contain information that is important for proper installation/operation. Compliance with **CAUTION** statements can prevent possible equipment damage and/or loss of data and are indicated as follows:

CAUTION



You risk damaging your equipment and/or software if you do not follow these instructions.

NOTE statements contain information that has been found important enough to be called to the special attention of the operator and is set off from the text as follows:



If you change the value of the LECS control parameters while the LECS process is running, the new values do not take effect until the LECS process is stopped, and then restarted.

Invisible Laser Radiation Notice

Class 1 Laser Product: This product conforms to applicable requirements of 21 CFR 1040 at the date of manufacture.

Class 1 lasers are defined as products which do not permit human access to laser radiation in excess of the accessible limits of Class 1 for applicable wavelengths and durations. These lasers are safe under reasonably foreseeable conditions of operation. Do not view beam with optical instruments.

Single mode fiber optic network modules contain a Class 1 laser.



This Laser Notice section only applies to products or components containing Class 1 lasers.

Safety Precautions

For your protection, observe the following safety precautions when setting up equipment:

- Follow all warnings and instructions marked on the equipment.
- Ensure that the voltage and frequency of your power source matches the voltage and frequency inscribed on the equipment's electrical rating label.
- Never push objects of any kind through openings in the equipment. Dangerous
 voltages may be present. Conductive foreign objects could produce a short circuit
 that could cause fire, electric shock, or damage to your equipment.

Modifications to Equipment

Do not make mechanical or electrical modifications to the equipment. FORE Systems, Inc., is not responsible for regulatory compliance of a modified FORE product.

CHAPTER 1 AMI Overview

ForeThought switch software provides switch and connection management, IP connectivity, and SNMP network management. The Switch Control Software (SCS) is the "brains" of the switch. The SCS controls the switch board(s) and handles connection set-up and tear-down duties. The SCS can also communicate with other FORE Systems switches to learn network topology and establish connections across multiple switches. In addition, there is an SNMP agent built into the SCS to allow SNMP management and control.

The user interface to the SCS is called the ATM Management Interface (AMI). AMI can be run on any ForeRunner switch running ForeThought switch software version 3.0.1 or later and any TNX switch running *ForeThought* switch software version 5.2 or later. This chapter contains a description of how to log in and navigate in AMI. AMI allows you to configure and to make statistical queries of various hardware and software aspects of ForeRunner and TNX switches and network modules by providing a hierarchical menu system similar to a UNIX file system. A single root menu provides a number of commands. Some of those commands, in turn, call submenus which provide a number of subcommands. At any given time, the AMI prompt indicates your current location within the AMI menu. You can traverse a menu one level at a time, or can traverse a number of levels simultaneously if the entire command string is known. For example, to show the current configuration of the network modules, enter the following at the prompt:

```
myswitch::> configuration module show
```

rather than entering one command line at a time as follows:

```
myswitch::> configuration
myswitch::configuration> module
myswitch::configuration module> show
```

Additionally, you only need to enter the minimum number of letters in a command which would make the command unique to that level. For example, you could enter com s instead of configuration module show. However, the minimum number of letters entered must also distinguish the command from global commands, such as up. For example, you would have to enter upc to distinguish upc from the global command up.

AMI is described throughout this chapter using the following conventions:

- All AMI output, including user prompts, is shown in courier font.
- All user input; e.g., sub-commands, is shown in bold courier font.
- Each submenu is described in a separate section.
- Commands that are submenus are immediately followed by a ">" symbol. The ">" should not be entered as part of the command.
- Required parameter values are indicated inside angle brackets "< >". The "< >" should not be entered as part of the command.
- Optional parameter values are indicated inside square brackets "[]". The "[]" should not be entered as part of the command.
- Parameter values that require a choice are separated by vertical bars and are enclosed in parentheses "(|)" Neither the vertical bar nor the parentheses should be entered as part of the command.
- Optional parameter names are indicated with dashes "-".
- All port numbers are in BNP (board, network module, port) notation. For example, 1A4 indicates the first switch board, network module A, port 4. For more information about port numbering, see the Installation and Maintenance manual for your switch.
- AMI commands are not case-sensitive.

1.1 Logging into a Switch

You can log in to a switch in several different ways: via the serial port, via telnet, via a remote AMI session from another switch, or via *ForeView*. The first three methods are described here. For information about logging in via *ForeView*, please see the *ForeView Network Management User's Manual*. Initially, you must log in to the switch through the serial port.

1.1.1 Login from the Serial Port

When connecting to the switch via the serial port, only one user may open an AMI session on an SCP at a time. If an AMI session is already in use, and you attempt to log in through the serial port, you receive a message similar to the following:

```
Userid <<userid>> is already logged into AMI. Disable it? (y/n)
```

Entering y disables the other user's session and allows you to log in. Entering n aborts your login attempt.

On a new switch running ForeThought 5.2.x, there are two separate default userids: ami and asx. Both are configured with the local authentication method, with admin privileges (meaning you are allowed to use all AMI commands), and all access (meaning you are allowed to login to the switch using all the possible methods). Both userids are assigned a null password.

At the login prompt, you must enter your userid. For example:

```
login: ami <ENTER>
```

If your userid has no assigned password, you are not prompted for a password and the following message is displayed:

```
Warning: Userid ami does not have a local password set.

Please use "configuration security login password"

to set the local password.
```



It is highly recommended that you assign a password to the ami userid and to the asx userid, since these userids have admin privileges by default. For more information, see the AMI Configuration Commands Reference Manual.

On subsequent logins, you will be prompted for a password as follows:

Password:

Enter the password that has been assign for your userid. For security reasons, the switch does not echo your keystrokes when you enter a password.



After three unsuccessful login attempts, there is a five-second delay before you may attempt to login again.

If you login with a userid that has been configured for SecurID authentication, you are instead prompted for the two-part SecurID passcode:

```
Enter PASSCODE: <PIN><Code on SecurID Token> <ENTER>
```

If you enter an incorrect passcode three times in a row, you are prompted to enter the two-part SecurID passcode <u>and</u> the next Tokencode. At the next Tokencode prompt, wait until the display changes on your SecurID token and enter either your PIN number and that next code number, or just that next code number.

login: test1
Enter PASSCODE:
Login incorrect

login: test1
Enter PASSCODE:
next Tokencode:

Once you enter either the correct local password or the correct SecurID passcode, the following is displayed and a session is opened on the SCP:

```
ATM Management Interface v5.2.0

Copyright (c) 1994-1998 FORE Systems, Inc.

General commands:
    '?' to get list of commands at the current level
    'up' to go up one menu level
    'top' to go to the root menu
    'exit' to leave AMI

Opening a session for "127.0.0.1", please wait...

Connected to "127.0.0.1" (asx200bx).
```



There are several different possible login scenarios. See the Network Configuration manual for your switch for a list of scenarios and the action the switch takes for each.

1.1.2 Login from Telnet

To telnet to the SCP, enter the following parameters at the > prompt on the host:

```
> telnet <address>
```

address Enter the IP address of the SCP.

For example, to telnet to an SCP with the IP address 204.95.89.231, enter the following:

```
> telnet 204.95.89.231
```

Only one user may open an AMI session on an SCP at a time. If an AMI session is already in use, and you attempt to log in through a telnet session, you receive a message similar to the following and are prevented from logging into the switch:

```
Userid <<userid>> is already logged into AMI. Exiting...
```

If no other AMI session is running, something similar to the following is displayed:

```
Trying 204.95.89.231 ...

Connected to fishtank.

Escape character is '^]'.

S_ForeThought_5.2.0 (1.13304) (asx200bx) (fishtank)
```

Above, S_ForeThought_5.2.0 (1.13304) indicates the version of software, (asx200bx) indicates what type of switch this is, and (fishtank) indicates the name that has been assigned to this SCP. If (ATM SWITCH) is displayed for the SCP name, this means that no host name has been assigned yet.

On a new switch running ForeThought 5.2.x, there are two separate default userids: ami and asx. Both are configured with the local authentication method, with admin privileges (meaning you are allowed to use all AMI commands), and all access (meaning you are allowed to login to the switch using all the possible methods). Both userids are assigned a null password.

At the login prompt, you must enter your userid. Type your assigned userid for the login and then enter the assigned password. For example:

```
login: myuserid <ENTER>
Password: <ENTER>
```

For security reasons, the switch does not echo your keystrokes when you enter a password.



After three unsuccessful login attempts, there is a five-second delay before you may attempt to login again.

If you do not log in and enter the password within 60 seconds, the telnet session times out with the following message:

```
login: Login timed out after 60 seconds
```

If SecurID authentication has been configured, you are instead prompted for the two-part SecurID passcode:

```
Enter PASSCODE: <PIN><Code on SecurID Token> <ENTER>
```

If you enter an incorrect passcode three times in a row, you are prompted to enter the two-part SecurID passcode <u>and</u> the next Tokencode. At the next Tokencode prompt, wait until the display changes on your SecurID token and enter either your PIN number and that next code number, or just that next code number.

```
login: test1
Enter PASSCODE:
Login incorrect

login: test1
Enter PASSCODE:
Login incorrect

login: test1
Enter PASSCODE:
```

next Tokencode:

Once you enter either the correct local password or the correct SecurID passcode, the following is displayed and a session is opened on the SCP:

```
ATM Management Interface v5.2.0

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General commands:
    '?' to get list of commands at the current level
    'up' to go up one menu level
    'top' to go to the root menu
    'exit' to leave AMI

Opening a session for "127.0.0.1", please wait...

Connected to "127.0.0.1" (asx200bx).
```



There are several different possible login scenarios. See the Network Configuration manual for your switch for a list of scenarios and the action the switch takes for each.

1.1.3 Logging in Remotely

You can also log in to another switch remotely using the open command. See Section 1.2.9 for more information. This does not require the use of a password. For example, if you are locally logged in to a switch called fishtank (there is no asterisk (*) in front of the prompt), you can open a session to another switch. That switch's name is displayed with an asterisk (*) in front of it as your prompt.

```
fishtank::> open 208.121.29.2 private
Opening a session for "208.121.29.2", please wait...
Connected to "208.121.29.2" (asx200bx).
*shark::>
```

To return to the local session, you must type localhost (instead of the prompt name).

```
*shark::> localhost
fishtank::>
```

1.1.3.1 AMI Commands Not Available Remotely

When you log in to a switch remotely, some of the AMI commands are not available. In the above example, since you are logged in locally to a switch called fishtank and you open a remote session to a switch called shark, some AMI commands will not work on shark. The following commands are not available remotely when running a remote AMI session on an ASX-1000, ASX-200BX, ASX-200WG (with a 16 MB SCP), LE 155, TNX-1100, or a TNX-210:

- · configuration system prompt
- configuration system syslog
- configuration system timeout
- operation cdb init
- · operation flash>
- operation panic>
- operation reboot
- operation version

1.2 AMI Root Menu for an Open Session

This menu is the root submenu for an AMI session. By typing a "?" at any prompt, a list of available commands at the current level is displayed. By typing a "?" at this root level prompt, the following list of available commands is shown:

myswitch::> ? about close configuration> debug> display> exit help history open operation> ping redo statistics> top rows up

Each of these root level commands is described in the following subsections.

1.2.1 About Command

By entering the about command at the root level prompt, you can display information regarding AMI and how to begin an AMI session on a host or on a switch.

myswitch::> about

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AMI uses SNMP to manage FORE Systems' ATM switches.

AMI is platform independent and runs on hosts and FORE ATM switches.

When AMI is executed on a host, you must first use the OPEN command to specify the switch to manage. If AMI is started on a switch, it immediately opens a connection to itself.

1.2.2 Close Command

Any number of sessions may be opened to remote SCPs from your local SCP. An asterisk (*) is displayed in front of the remote switch's prompt to distinguish the local switch session from the remote one. However, only one AMI session per switch may be open at any time. By typing close at the prompt, you can end the current AMI session.

If an individual session is closed, you are sent back to the last session that is still open. For example, if you opened a session on switch1 and on switch2 from your local SCP (myswitch), and you wanted to close the session on switch2, you would be sent back to the last open session which is on switch1 as follows:

```
*switch2::> close
*switch1::>
```

If you decided to close the session on switch1, you would be sent back to the last open session which is on your local SCP as follows:

```
*switch1::> close
myswitch::>
```

If all sessions are closed, you are sent back to the root prompt as follows:

```
myswitch::> close
>
```

At this point, you can open another session or exit the switch.

1.2.3 Configuration Commands

By entering configuration at the root level, you can access a directory of subcommands that allow you to configure specific parts of the hardware or specific properties of the software. These commands are described in detail in the AMI Configuration Commands Reference Manual.

1.2.4 Debug Commands

By entering debug at the root level, you can access a directory of subcommands that give you more information which may help you to troubleshoot specific parts of the software. These commands are described in detail in the Diagnostics and Troubleshooting manual for your switch.

1.2.5 Display Commands

This command lets you display ATM routing information. You can display the available sub-command by typing? at the display level. By entering display at the root level, you can access a directory of subcommands that allow you to display more ATM routing information. These commands are described in detail in Chapter 2 of this manual.

1.2.6 Exit Command

The exit command lets you log out of the main AMI system. When entered, this command ends all open sessions on the SCP. Enter the following:

```
myswitch::> exit
Connection closed by foreign host.
```

1.2.7 Help Command

By typing help at any submenu level, a list of available commands at the current level, and a short description of each command, is shown. By typing help at the root level, the following commands and descriptions are shown:

```
myswitch::> help
General commands:
  '?' to get list of commands at the current level
  'up' to go up one menu level
  'top' to go to the root menu
  'exit' to leave AMI
  about
                         - Display program information
  close
                         - Close this connection
 configuration>
                         - System configuration submenu
                         - Switch debug submenu
 debug>
                         - Switch display submenu
 display>
  exit
                         - Exit AMI
 help
                         - Display help for each command
                         - Display command history
 history
                         - Open a connection
  open
  operation>
                         - Switch operation submenu
 ping
                         - Ping a host or switch
 redo
                         - Repeat a history command
                         - Get/set number of rows
 rows
                         - Switch statistics submenu
  statistics>
  top
                         - Go to the root menu
                         - Go up 1 menu level
  up
```

1.2.8 History Command

By typing history at any prompt, you can list up to the last 50 previously typed commands for that particular session:

```
myswitch::> history
    35 peer
    36 ptse
   37 stmap
    38 help
    39 ..
    40 ?
    41 span
   42 ?
    43 map
   44 ..
    45 help
    46 sp
    47 help
    48 con
    49 ?
    50 ..
    51 ?
   52 help
    53 ?
    54 his
```

1.2.9 Open Command

The **open** command lets you begin a session on a remote switch. At the prompt, enter the following parameters:

```
myswitch::> open <switch> [<community>]
```

These parameters are defined as follows:

Parameter	Description
switch	The IP address of the remote switch on which you want to open a session.
community ¹	The SNMP community string that indicates the level of access that you have on the switch. The default is public, which allows read-only access.

^{1.} Although the default SNMP community string is public, you must use the private SNMP community string if you wish to make any changes on the remote SCP (e.g., if you want to create a SPANS SPVC to that SCP).

For example, to log in to a remote switch called fishtank that has an IP address of 192.25.6.113 using the private community string, enter the following parameters:

```
myswitch:> open 208.29.16.113 private
Opening a session for "208.29.16.113", please wait...
Connected to "208.29.16.113" (asx200bx).
*fishtank::>
```

An asterisk (*) is displayed in front of the remote switch's prompt to distinguish the local switch from the remote one.

If another user already has an AMI session open on that SCP, then you are not permitted to log in to that SCP. You receive the following message:

```
Userid "eng" is already logged into AMI. Exiting...
Connection closed by foreign host.
```

If the remote switch to which you are connecting is running a different software version than the local switch, you receive the following caution:

```
myswitch::> open 209.21.14.108
Opening a session for "209.21.14.108", please wait...
Connected to "209.21.14.108" (asx200bx).
Host 209.21.14.108 running a different version. There may be some incompatibilities.
```

1.2.10 Operation Commands

By entering operation at the root level prompt, you can access a directory of subcommands that allow you to manage various parts of the switch. These commands are described in detail in Chapter 3 of this manual.

1.2.11 Ping Command

The ping command lets you send a ping to another switch or a host to see if it is "alive," or reachable, by sending it an ICMP echo request and waiting for a response. You can access this command by entering ping at the root level. Enter the following parameters:

```
myswitch::> ping <IP-address>
```

This parameter is defined as follows:

Parameter	Description
IP-address ¹	The IP address of the host or switch to which the ping is sent.

^{1.} The ping is always sent from the first switch or host on which AMI was originally started. For example, you are logged into switch A. From there, you open a session to switch B. If you enter the ping command while in your session on switch B, the ping is sent from switch A, NOT from switch B.

1.2.12 Redo Command

The redo command can be used in conjunction with the history command. It lets you repeat a command that was given in the same open session. You can access this command by entering redo at any level. To repeat the last command that was performed, enter redo with no additional parameters as follows:

```
myswitch::> redo
```

To repeat a command given within the last 20 commands in the same open session, enter the following parameters:

```
myswitch::> redo <command-number>
```

This parameter is defined as follows:

Parameter	Description
command-number	The command and the number associated with the command that was previously performed by the switch during this same session. Enter the history command to list the previous commands and their associated numbers as shown in the following example.

Type history at the prompt to list the last 20 previously typed commands for that particular session as follows:

myswitch::> history

- 1 oper env cpu
- 2 stat
- 3 ?
- 4 module
- 5 show
- 6 port
- 7 spans
- 8 tcp
- 9 udp
- 10 vcc
- 11 help
- 12 history

Then, to repeat a previously given command, type **redo** and the command number at the prompt. For example, to repeat command number 8, which is listing statistics for tcp, enter the following:

myswitch::> redo 8	
tcp Counter	Value
tcpActiveOpens	1
tcpPassiveOpens	49
tcpAttemptFails	0
tcpEstabResets	1
tcpCurrEstab	1
tcpInSegs	14060
tcpOutSegs	9967
tcpRetransSegs	0

1.2.13 Rows Command

The **rows** command allows users to set the number of rows that their terminal displays. Users can access this command by entering **rows** at the root level as follows:

```
myswitch::> rows [<rows>]
Terminal Rows = 24
```

This parameter is defined as follows:

Parameter	Description
rows	The number of terminal rows to be used.

1.2.14 Statistics Commands

By entering statistics at the root level, you can access a directory of subcommands that display operational performance and error information for the various hardware and software features of the switch and the network modules. These commands are described in detail in Chapter 4 of this manual.

1.2.15 Top Command

By entering top at any level, you are sent to the root level of AMI. For example, if you are at the operation cdb level and you want to go directly to the root level, simply enter top at the prompt as follows:

```
myswitch::operation cdb> top
myswitch::>
```

1.2.16 Up Command

Entering up allows you to go up one menu level. For example, if you are at the configuration port traffic level and you want to go one level above that to configuration port, simply enter up at the prompt as shown here.

```
myswitch::configuration port traffic> up
myswitch::configuration port>
```

Entering the characters .. has the same effect as entering the command up. For example,

```
myswitch::configuration port traffic> ..
myswitch::configuration port>
```

1.3 AMI Command Line Editing

This feature allows easier configuration of the switch. You scroll through the commands stored in AMI's history. Then you can edit the lines by deleting, inserting, and replacing characters. This is particularly useful if you need to enter several long command strings that are similar.

When editing a line, the current cursor position is always in "insert" mode. Cursor movements are controlled using standard ANSI terminal escape sequences. Non-ANSI terminals are not supported.

The following key sequences are supported by this feature:

Key Sequence	Description
up and down arrow keys	The up and down arrows keys on a standard keyboard let you toggle through the history of AMI commands. The up arrow displays the previous command in AMI's history. The down arrow displays the following command in AMI's history.
left and right arrow keys	The left and right arrows let you move the cursor over a displayed AMI command. The displayed line is not modified. Only the cursor position is changed.
Control-P	This key sequence has the same effect as using the up arrow key.
Control-N	This key sequence has the same effect as using the down arrow key.
Control-B	This key sequence has the same effect as using the left arrow key.
Control-F	This key sequence has the same effect as using the right arrow key.
Control-A	This key sequence moves the cursor to the beginning of the line being edited.
Control-E	This key sequence moves the cursor to the end of the line being edited.
Control-H	This key sequence deletes the character before the current cursor position.
Control-D	This key sequence deletes the character under the current cursor position.
Control-K	This key sequence deletes everything on the line being edited from the current cursor position to the end of the line. The deleted characters are saved in a temporary buffer.
Control-U	This key sequence deletes all characters on the current line. The deleted characters are saved in a temporary buffer.
Control-Y	This key sequence restores the characters that were deleted by the last Control-K or Control-U sequence. This key sequence has no effect if nothing has been deleted.
Control-J	This key sequence returns the current line to AMI to be executed.
Control-L	This key sequence clears the terminal screen. The current AMI prompt and the current AMI command are re-displayed at the top of the screen.

AMI Overview

CHAPTER 2

AMI Display Commands

This chapter contains a detailed description of the AMI display commands. The main display menu can be found at the root level. There is one main menu under display that contains other submenus. Commands that are submenus are immediately followed by a ">" symbol. Typing? at the display level lists these commands as follows:

```
myswitch::display> ?
  atmroute>
```

2.1 Displaying ATM Routing Information

These commands let you display ATM routing information. You can display the list of available subcommands by typing? at the atmroute level.

```
myswitch::display atmroute> ?
  ftpnni>    ptab     pnni>    spans>
```

2.1.1 Displaying FT-PNNI Routing Information

This command lets you display *ForeThought* PNNI route information. You can display the list of available subcommands by typing? at the ftpnni level.

```
myswitch::display atmroute ftpnni> ?
map
```

2.1.1.1 Displaying FT-PNNI Network Map Information

This command lets you display the *ForeThought* PNNI topology database. This database consists of logical links (loglinks). Enter the following parameters:

```
myswitch::display atmroute ftpnni> map
Board Src
                                                    SrcMask SrcPort SrcVpi
      0x0
                                                                      0x0
                                                 DestMask DestPort DestVpi
    0x47.0005.80.ffe100.0000.f31c.274d.000000000000.00 104
                                                          0xfffe
      Cost Freshness UbrVCs CbrCapacity CbrFifo VbrCapacity VbrFifo
      100 2
                   0
                                     256
                          INF
                                            INF
      Oria
                      CapabilitySet
      ilmi-registered 0x08000000
Board Src
                                                    SrcMask SrcPort SrcVpi
      0x47.0005.80.ffe100.0000.f21c.274d.000000000000.00 104
                                                            0x0
     Dest
                                                 DestMask DestPort DestVpi
     0x47.0005.80.ffe100.0000.f31c.274d.000000000000.00 104
      Cost Freshness UbrVCs CbrCapacity CbrFifo VbrCapacity VbrFifo
      100 2
                          INF
                                     256
                                             INF
      Orig
                      CapabilitySet
      ilmi-registered 0x10000000
Press return for more, q to quit: q
```

Field	Description
Board	The index number of this switch board.
Src	The ATM address of the prefix of the source of this loglink.
SrcMask	The number of bits that are significant in the Src address.
SrcPort	The port through which the loglink is attached at the source.
Dest	The ATM address of the prefix of the destination of this loglink.
DestMask	The number of bits that are significant in the Dest address.
DestPort	The port through which the loglink is attached at the destination.
Cost	The administrative routing cost of this loglink.
Freshness	The freshness of this loglink. The smaller the number, the more fresh the information is.
UbrVCs	The number of active UBR connections over this link.
CbrCapacity	The available capacity for CBR connections, in Kbps.
CbrFifo	The current size of the CBR FIFO buffer, in number of cells.

Field	Description
VbrCapacity	The available capacity for VBR connections, in Kbps.
VbrFifo	The current size of the VBR FIFO buffer, in number of cells.
Orig	The source of this routing information.
CapabilitySet	A bitmap indicating the capabilities of this link. The possible values are as follows: 0x80000000 - This is a SPANS NNI border link. 0x40000000 - This is a FT-PNNI border link. 0x20000000 - VCs are depleted on this link. 0x10000000 - This is the FT-PNNI backbone link. 0x08000000 - This is a FT-PNNI PGSN reachability link. 0x02000000 - This is a static reachability link. 0x01000000 - This is a FT-PNNI exterior reachability link. 0x008000000 - This is a bidirectional link. 0x00400000 - This is a non-transit link. 0x00040000 - This link supports Available Bit Rate (ABR). 0x00001000 - This link supports Early Packet Discard (EPD).

2.1.2 Displaying Routing Prefix Table Information

This command lets you display the contents of the prefix tables. A routing prefix table consists of prefix nodes. There are prefix table entries (PTEs) associated with each prefix node. See Chapter 5 of the ATM *Switch Diagnostics and Troubleshooting Manual* for more information about reading this table. Enter the following parameters:

```
myswitch::display atmroute> ptab
Domain Prefix
                                                Len Flags
                                                               TimeStamp
       47.000580ffe1000000f21a3445.002048067f56
                                                152 0x0
                                                                334102be
       OwnerLevel OwnerProtocol OwnerPathFlags
             ilmi
                               0x0
       PTEs:
       ProtoId ProtoHndl Protocol PathFlags Level Area Scope SrcArea Type
                                         255
              0xb6fef0 pnni
                                 0 \times 0
                                                                    1
Domain Prefix
                                                Len Flags
                                                               TimeStamp
       47.000580ffe1000000f21a3445.0020480682e5
                                                152 0x2
                                                                33410311
       OwnerLevel OwnerProtocol OwnerPathFlags
                ilmi
                                0x0
Domain Prefix
                                                Len Flags
                                                               TimeStamp
       47.000580ffe1000000f21a3445.0020481a3445
                                                152 0x0
                                                                334102ad
       OwnerLevel OwnerProtocol OwnerPathFlags
       255
                ilmi
                                0x0
       PTEs:
       ProtoId ProtoHndl Protocol PathFlags Level Area Scope SrcArea Type
               0xc12890 pnni
                                 0x0
                                       255 0
```

Field	Description
Domain	The index of the domain to which the prefix table belongs.
Prefix	The ATM address prefix of this prefix node.
Len	The number of bits in the prefix that are significant.
Flags	The flag bitmask of this prefix node. The possible values are as follows: 0x0 - There is no flag set. 0x1 - The prefix node is currently in the change list. 0x2 - The prefix node has no valid registered PTE. 0x3 - Both the 0x1 and 0x2 flags are set.

Field	Description
Timestamp	The time at which this prefix node was last updated.
OwnerLevel	The level of the most preferable PTE.
OwnerProtocol	The protocol type of the most preferable PTE.
OwnerPathFlags	The path flags of the most preferable PTE.
PTE ProtoId	The protocol ID of the entity that registers this PTE with the prefix table. 0 is used for local prefixes, and n (1,2,) indicates the index of the node that registered the PTE.
PTE ProtoHndl	The handle that the registerer uses to identify this PTE.
PTE Protocol	The protocol type of this PTE's registerer.
PTE PathFlags	The flag bit mask of this PTE. The possible values are as follows:
	0x0 - There is no flag set.
	0x1 - The PTE corresponds to a locally generated PTSE.
PTE Level	The FORE level of this PTE's registerer.
PTE Area	The FORE area of this PTE's registerer.
PTE Scope	The advertisement scope of this PTE.
PTE SrcArea	The source area of this PTE.
РТЕ Туре	The type of this PTE. 0 means this is an exterior PTE and 1 means it is internal.

You can also display information for a specific domain by entering the following:

```
myswitch::display atmroute> ptab [<domainid> [<prefix> [<plen>]]]
myswitch::display atmroute> ptab 1
```

or you can display information for a specific domain, prefix, and length as follows:

```
myswitch::display atmroute> ptab [<domainid> [<prefix> [<plen>]]]
myswitch::display atmroute> ptab 1 47.000580ffe1000000f21c1f4e.0020481c1f4e 152
Domain Prefix
                                                  Len Flags
                                                                  TimeStamp
       47.000580ffe1000000f21c1f4e.0020481c1f4e
                                                  152 0x0
                                                                  3535c02d
       OwnerLevel OwnerProtocol OwnerPathFlags
       255
                 ilmi
                                  0x0
       PTEs:
       ProtoId ProtoHndl Protocol PathFlags Level Area Scope SrcArea Type
        0
               0xe9108
                         static
                                  0x0
                                             255
                                                        0
                                                               0
                                                                        1
```

The fields in this display are defined in the same manner as those in the previous example.

2.1.3 Displaying ATM Forum PNNI Routing Information

These commands allow you to display information about ATM Forum PNNI routing in your network. You can display the list of available subcommands by typing? at the pnni level.

2.1.3.1 Displaying PNNI Link Information

This command lets you display the PNNI link table, which shows all of the links attached to a node and other information about each link. Enter the following parameters:

```
myswitch::display atmroute pnni> link
Node Port VPI PortId HelloState
                            Version
                                       LinkType
    3A4 0 10000003 twoWayInside versionlpoint0 lowestLevelHorizontalLink
    RmtNodeId
                                          RmtPortId
    80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00 10000008
Node Port VPI PortId HelloState Version
                                       LinkType
    3E1 0
          10000020 attempt version1point0 unknown
    RmtNodeId
                                          RmtPortId
    Node Port VPI PortId HelloState Version
                                       LinkType
    3E2 0 10000021 attempt version1point0 unknown
    RmtNodeId
                                          RmtPortId
    0
Node Port VPI PortId HelloState Version
                                       LinkType
    3E4 0 10000023 attempt version1point0 unknown
    RmtNodeId
                                          RmtPortId
```

Field	Description
Node	The index number of the node to which the displayed link is attached.
Port	The port through which the link is attached to the node.
VPI	The virtual path number on the port on which the PNNI protocol is running.
PortId	The port identifier for this link.

Field	Description
HelloState	The state of the hello protocol running between the peer nodes. <code>down</code> means that the link is not usable, so no routing packets are sent or received over it. <code>attempt</code> means that either no hellos or hellos with mismatch information have been received from the neighbor, and attempts are being made to reach the neighbor by sending hellos at the specified hello interval. <code>oneWayInside</code> means that hellos have been received from the neighbor and the neighbor has established that they are peers, but the neighbor's remote node ID and remote port ID are <code>0.twoWayInside</code> means that hellos have been received from the neighbor, the neighbor has established that they are peers, and the neighbor has sent the correct remote node ID and remote port ID. Bi-directional communication can occur over this link. <code>oneWayOutside</code> means that hellos have been received from the neighbor and the neighbor has established that they are from different peer groups, but the neighbor's remote node ID and remote port ID are <code>0.twoWayOutside</code> means that hellos have been received from the neighbor, the neighbor has established that they are from different peer groups, and the neighbor has sent the correct remote node ID and remote port ID, but the nodal hierarchy list does not include a common peer group. <code>commonOutside</code> means that a common level of the routing hierarchy has been found and bi-directional communication can occur over this link.
Version	The version of ATM Forum PNNI that the peer nodes are using for this hello protocol.
LinkType	The type of link between the two peers. Can be unknown, lowestLevelHorizontalLink, horizontalLinkToFromLgn, lowestLevelOutsideLink, uplink, or outsideLinkAndUplink.
RmtNodeId	The node ID of the peer node.
RmtPortId	The port ID that identifies the link in the peer node.

You can also display information for a specific node by entering disp atmr pnni link <nodeix>. You can also display information for a specific node, port, and vpi as follows:

```
myswitch::display atmroute pnni> link [<nodeix>] [<port> <vpi>]
myswitch::display atmroute pnni> link 1 4e1 0

Node Port VPI PortId HelloState Version LinkType
1 4E1 0 10000020 twoWayInside version1point0 lowestLevelHorizontalLink

RmtNodeId RmtPortId
80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00001.00 10000023
```

The fields in this display are defined in the same manner as those in the previous example. If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> link
No link information is available
```

2.1.3.2 Displaying PNNI Map Information

This command lets you display information about horizontal links, uplinks, and nodal state elements of the network. See Chapter 5 of the ATM *Switch Diagnostics and Troubleshooting Manual* for more information about reading this table. Enter the following parameters:

myswit	yswitch::display atmroute pnni> map										
Node	OriginatingNodeId OrigPortId Index										
1	80:160:4	7.000580f	Ee10000	000f2121	f4e.ff	lc1f4e0	002.00	0x100	00008 1	L	
	Type	Pee	erGroup	pId			AggrT	oken F	RmtPortl	Ιd	
	horizonta	alLink 80	:47.000)580ffe1	.0000001	E200000	0 0	()x100000	003	
	RemoteNoo	deId						VpCap	PTSEIC	l	MTag
	80:160:47	7.000580fi	Ee10000	000f21c1	042.ff	lc10420	001.00	0	0x1000	80000	0
	Category	Dir	AdmWt	MCR	ACR	CTD	CDV	CLR0	CLR0+1	CRM	VF
	cbr	outgoing	5040	353207	353199	745	725	8	8	0	0
	rtvbr	outgoing	5040	353207	353199	745	725	8	8	0	0
	nrtvbr	outgoing	5040	353207	353199	745	725	8	8	0	0
	ubr	outgoing	5040	353207	353199	745	725	8	8	0	0
Node	Originat	ingNodeId						Orig	ortId 1	Index	
1	80:160:47	7.000580f	Ee10000	000f2121	f4e.ff	lc1f4e0	002.00	0x100	00020 1	L	
	Type	Pee	erGroup	pId			AggrT	oken F	RmtPortl	Ιd	
	horizonta	alLink 80	:47.000	0580ffe1	.0000001	E200000	0 0	()x100000	023	
	RemoteNoo	deId						VpCap	PTSEI	l	MTag
	80:160:47	7.000580fi	Ee10000	000f21c1	fe0.ff	lc1fe00	001.00	0	0x1000	00020	0
	Category	Dir	AdmWt	MCR	ACR	CTD	CDV	CLR0	CLR0+1	CRM	VF
	cbr	outgoing	5040	5660377	56603	77 0	0	8	8	0	0
	rtvbr	outgoing	5040	5660377	56603	77 0	0	8	8	0	0
	nrtvbr	outgoing	5040	5660377	56603	77 0	0	8	8	0	0
	ubr	outgoing	5040	5660377	56603	77 0	0	8	8	0	0

Field	Description
Node	The index number of the node.
OriginatingNodeId	The node identifier of the node that generated the PTSE.
OrigPortId	The port identifier with which the originating node identifies this topology link.
Index	The index number of the link with the same originating node ID and port ID.
Туре	Shows what type of link this is. Can be horizontal link or uplink.
PeerGroupId	The peergroup identifier of the node that generated the PTSE.
AggrToken	For uplinks and for horizontal links and uplinks between Logical Group Nodes (LGNs), shows the derived aggregate token value.

Field	Description
RmtPortId	For horizontal links and uplinks, shows the port identifier of the port at the remote end of the link as assigned by the remote node. For nodal state elements, shows the port identifier of the port at the other end of the spoke or bypass from the originating port.
RemoteNodeId	For horizontal links and uplinks, shows the node identifier of the node at the other end of the link.
VpCap	Shows whether or not VPs can be established across this link. 0 means they cannot. This is a read-only field.
PTSEId	The PTSE identifier.
MTag	The metrics tag which identifies a set of traffic parameters.
Category	The class of service that applies to this link.
Dir	The direction of the link to which the traffic parameters apply.
AdmWt	The administrative weight assigned to this link.
MCR	The maximum cell rate assigned to this link.
ACR	The available cell rate of this link.
CTD	The cell transfer delay on this link.
CDV	The cell delay variation assigned to this link.
CLR0	The maximum cell loss ratio for CLP=0 traffic on this link.
CLR0+1	The maximum cell loss ratio for CLP=0+1 traffic on this link.
CRM	The cell rate margin on this link.
VF	The variance factor on this link.

You can also display address information about a specific node, or a specific originating node ID, or a specific originating port ID, or a specific index. Enter the following to display address information about a specific node:

```
myswitch::display atmroute pnni> map [<nodeix> [<orignodeid> [<origportid>
 [<index>]]]]
myswitch::display atmroute pnni> map 1
Node OriginatingNodeId
                                                          OrigPortId Index
     80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00 0x10000008 1
                     PeerGroupId
                                                    AggrToken RmtPortId
     horizontalLink 80:47.000580ffe1000000f2000000 0
                                                              0x10000003
     RemoteNodeId
                                                         VpCap PTSEId
                                                                          MTag
      80:160:47.000580ffe1000000f21c1042.ff1c10420001.00 0
                                                                0x10000008 0
     Category Dir
                       AdmWt MCR
                                    ACR
                                           CTD
                                                   CDV
                                                         CLR0 CLR0+1 CRM VF
     cbr
              outgoing 5040 353207 353199 745
                                                   725
     rtvbr
               outgoing 5040 353207 353199 745
                                                   725
                                                               8
                                                                      Λ
                                                                           Λ
     nrtvbr
              outgoing 5040 353207 353199 745
                                                   725
                                                                      0
                                                                           0
     ubr
               outgoing 5040 353207 353199 745
                                                   725
                                                               8
                                                                      0
                                                                           0
Node OriginatingNodeId
                                                          OrigPortId Index
     80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00 0x10000020 1
                                                    AggrToken RmtPortId
                    PeerGroupId
     horizontalLink 80:47.000580ffe1000000f2000000 0
                                                              0x10000023
     RemoteNodeId
                                                          VpCap PTSEId
                                                                           MTag
      80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00001.00 0
                                                                0x10000020 0
                                                          CLR0 CLR0+1 CRM
     Category Dir
                       AdmWt MCR
                                     ACR
                                            CTD
                                                   CDV
               outgoing 5040 5660377 5660377 0
     cbr
                                                     0
                                                            8
     rtvbr
              outgoing 5040 5660377 5660377 0
                                                     0
                                                            8
                                                                 8
                                                                        0
                                                                             0
     nrtvbr outgoing 5040 5660377 5660377 0
                                                     Ω
                                                            8
                                                                 8
                                                                             n
                                                                        Ω
              outgoing 5040 5660377 5660377 0
                                                     0
      ubr
                                                                             0
```

The fields in this display are defined in the same manner as those in the previous example. If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> map
No map information is available
```

2.1.3.3 Displaying PNNI Map Address Information

This command lets you display all of the reachable addresses, including the Resource Availability Information Group (RAIG) information, if available. Enter the following parameters:

```
myswitch::display atmroute pnni> mapaddr
Node AdvertisingNodeId
                                                     AdvPortId Index
     80:160:47.000580ffe1000000f21c0201.ff1c02010001.00 0
                                                               1
                                           PrefixLength
     47.000580ffe1000000f21c0201.00000000000 104
Node AdvertisingNodeId
                                                     AdvPortId Index
     80:160:47.000580ffe1000000f21a00d5.ff1a00d50001.00 0
                                                               1
                                           PrefixLength
     47.000580ffe1000000f21a00d5.00000000000 104
Node AdvertisingNodeId
                                                     AdvPortId Index
     80:160:47.000580ffe1000000f21a00d5.ff1a00d50001.00 0
     Prefix
                                           PrefixLength
     AdvPortId Index
Node AdvertisingNodeId
     80:160:47.000580ffe1000000f21a23c0.ff1a23c00002.00 0
     Prefix
                                           PrefixLength
     47.000580ffe1000000f21a23c0.00000000000 104
```

Field	Description
Node	The index number of the node to which this topology database belongs.
AdvertisingNodeId	The identifier of a node that is advertising reachability to the address prefix.
AdvPortId	The port identifier used by the advertising node to reach the given address prefix.
Index	A unique index number that summarizes all of the addresses advertised by a node.
Prefix	The value of the ATM end system address prefix.
PrefixLength	The prefix length to be applied to the ATM end system address prefix.

You can also display address information about a specific node, or a specific originating node ID, or a specific originating port ID, or a specific index. Enter the following to display address information about a specific node:

The fields in this display are defined in the same manner as those in the previous example. If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> mapaddr
No mapaddr information is available
```

2.1.3.4 Displaying PNNI Map Node Information

This command lets you display PNNI map node information. Enter the following parameters:

```
myswitch::display atmroute pnni> mapnode
Node MapNodeId
   80:160:47.000580ffe1000000f21c0201.ff1c02010001.00
    PeerGroupId
                              AtmAddress
    80:47.000580ffe1000000f2000000 47.000580ffe1000000f21c0201.ff1c02010001.00
    RstrTransit ComplexRep RstrBranch DBOverld Leader LdrPriority
    false
              false false false false
    PreferredPeerGroupLeader
    Node MapNodeId
    80:160:47.000580ffe1000000f21a00d5.ff1a00d50001.00
    PeerGroupId
                              AtmAddress
    80:47.000580ffe1000000f2000000 47.000580ffe1000000f21a00d5.ff1a00d50001.00
    RstrTransit ComplexRep RstrBranch DBOverld Leader LdrPriority
              false
                       false false false
    PreferredPeerGroupLeader
     Press return for more, q to quit: q
```

Field	Description
Node	The index number of the node to which this topology database belongs.
MapNodeId	The node identifier of the node whose information is being displayed.
PeerGroupId	The Peer Group Identifier of the originating node.
AtmAddress	The ATM address of the originating node.
RstrTransit	Shows whether the originating node is restricted to not allow support of SVCs going through this node. true means SVCs are restricted from going through this node. false means SVCs are not restricted.
ComplexRep	Shows whether the originating node uses the complex node representation. true means that the complex node representation is used. false means that the simple node representation is used.
RstrBranch	Shows whether or not the originating node is able to support additional point-to-multipoint branches. true means that additional branches cannot be supported. false means that additional branches can not be supported.
DBOverId	Shows whether or not the originating node is currently operating in topology database overload state. true means that it is operating in database overload state. false means that it is not.

Field	Description
Leader	Shows whether or not the originating node claims to be the Peer Group Leader (PGL) of its peer group. true means that it claims to be the PGL. false means that it does not.
LdrPriority	Shows the leadership value advertised by the originating node.
PreferredPeerGroupLeader	Shows the node ID of the node which the originating node believes should be or is the PGL. If a preferred PGL has not been chosen, this value is set to all zeros.
ParentNodeId	Shows the node identifier of the parent Logical Group Node (LGN).
ParentAtmAddress	Shows the ATM address of the parent LGN.
ParentPeerGroupId	Shows the peergroup identifier of the parent peergroup.



The higher layer (parent) information is displayed only if the originating node is a PGL and if any higher layer information is available.

You can also display map information about a specific node, or a specific map node ID. Enter the following to display map information about a specific node:

The fields in this display are defined in the same manner as those in the previous example. If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> mapnode
No mapnode information is available
```

2.1.3.5 Displaying PNNI Precomputed Path Map Information

This command lets you display precomputed paths. The precomputed paths are shown as trees, such that each node has the next hop node towards the source of the tree, which is the node to which the Topology Database (TDB) belongs. For each CBR and VBR profile, three trees are computed: one optimized for Cell Delay Variation (CDV), one optimized for Cell Transfer Delay (CTD), and one optimized for administrative weight. For each ABR and UBR profile, only one trees is computed, which is optimized for administrative weight. When load balancing is enabled for ABR and UBR profiles, then, at most, three trees are computed with the other two trees containing the secondary and tertiary options for load balancing. See Chapter 5 of the ATM Switch Diagnostics and Troubleshooting Manual for more information about reading this table. Enter the following parameters:

```
myswitch::display atmroute pnni> pcmap
Node Profile Tree MapNodeId
            0
              80:160:47.000580ffe1000000f21a23c0.ff1a23c00002.00
    ParentNodeId
                                                     LocalPort
    80:160:47.000580ffe1000000f21a00d5.ff1a00d50001.00 10000000
                ACR CTD
    AdmWt MCR
                             CDV CLR0
                                         CI_{R}0+1
    10080 353207 353205 1490 725
Node Profile Tree MapNodeId
                80:160:47.000580ffe1000000f21a00d5.ff1a00d50001.00
    ParentNodeId
                                                     LocalPort
    80:160:47.000580ffe1000000f21c0201.ff1c02010002.00 10000010
    AdmWt MCR
                ACR CTD CDV CLR0 CLR0+1
    5040 353207 353205 745 725 8
                                           8
Node Profile Tree MapNodeId
                80:160:47.000580ffe1000000f21a23c0.ff1a23c00002.00
            Λ
                                                     LocalPort
    80:160:47.000580ffe1000000f21a00d5.ff1a00d50001.00 10000000
                              CDV
                                    CLR0 CLR0+1
    AdmWt MCR
                ACR
                       CTD
    10080 353207 353205 1490 725
Press return for more, q to quit: q
```

Field	Description	
Node	The index number of the source node of the tree being displayed.	
Profile	The index number of the profile of the tree being displayed.	

Field	Description
Tree	The tree number. For CBR and VBR profiles, 0 is for CDV, 1 is for CTD, and 2 is for administrative weight. For ABR and UBR, 0 is for administrative weight, and if load balancing is enabled, 1 is for the secondary load balancing option, and 2 is for the tertiary load balancing option.
MapNodeId	The node identifier of a given node in the tree.
ParentNodeId	The local node identifier of the next hop towards the source node. The value 0 indicates that there is no parent node.
LocalPort	The port through which the node is connected to the next hop node.
AdmWt	The total administrative weight from the source node to the node identified by MapNodeId.
MCR	The largest maximum cell rate from the source node to the node identified by MapNodeId.
ACR	The largest available cell rate from the source node to the node identified by MapNodeId.
CTD	The total cell transfer delay from the source node to the node identified by MapNodeId.
CDV	The total cell delay variation from the source node to the node identified by MapNodeId.
CLR0	The largest maximum cell loss ratio objective for CLP=0 traffic from the source node to the node identified by MapNodeId.
CLR0+1	The largest maximum cell loss ratio objective for CLP=0+1 traffic from the source node to the node identified by MapNodeId.

You can also display precomputed path information about a specific node, or a specific profile, or a specific tree, or a specific map node ID. Enter the following to display information about a specific node and profile:

The fields in this display are defined in the same manner as those in the previous example. If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> pcmap
No precomputed path information is available
```

2.1.3.6 Displaying PNNI Peer Information

This command lets you display information about all of the peers that this node knows about. Enter the following parameters:

The fields in this display are defined as follows:

Field	Description
nodeix	The index number of this node.
PeerRemoteNodeId	The node identifier of each of the neighboring peer nodes.
State	The state of the database exchange protocol running between this node and the neighboring peer listed. npdown means there are no active links to the neighboring peer. negotiating means the two peers are deciding which one will start the initial topology database exchange. exchanging means this node is sending its topology database to the neighboring node. loading means this node is receiving the neighboring node's topology database. full means this node has received all PTSEs known to be available from the neighboring peer. Links to the neighboring peer can now be advertised in PTSEs.
PortCount	The number of hello protocols running between the two peers.

You can also display peer information for a specific node or remote node ID. Enter the following parameters to display information for a specific node:

If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> peer
No peer information is available
```

2.1.3.7 Displaying PTSE Information

PNNI topology information can be grouped into small units called PNNI Topology State Elements (PTSEs) and then flooded through the network on a hop-by-hop basis. This command lets you display PTSE information. Enter the following parameters:

```
myswitch::display atmroute pnni> ptse
Node OriginatingNodeId
                                                       PtseId
     80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00 1
                               SequenceNum Checksum LifeTime
     nodalInformation
                               5 ca71 3599
Node OriginatingNodeId
                                                       PtseId
     80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00 10000008
                               SequenceNum Checksum LifeTime
     horizontalLinks
                                          f217 3599
Node OriginatingNodeId
                                                       PtseId
     80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00 10000020
     Туре
                               SequenceNum Checksum LifeTime
                                          f107 3599
     horizontalLinks
Node OriginatingNodeId
     80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00 50000000
1
                               SequenceNum Checksum LifeTime
     Type
     internalReachableAddresses 6
                                         c250 3599
Press return for more, q to quit: q
```

Field	Description
Node	The index number of the node.
OriginatingNodeId	The node ID of the node that originated the PTSE.
PtseId	The PTSE identifier that was assigned by the originating node.
Туре	Shows what kind of PTSE this is. Can be nodalInformation, internalReachableAddresses, externalReachableAddresses, nodalStateParameters, horizontalLinks, or uplinks.
SequenceNum	The sequence number of the PTSE that was assigned by the originating node.
Checksum	The checksum of the PTSE.
LifeTime	The remaining life time of the PTSE before it is flushed out.

This command also lets you display advanced information about PTSEs. Enter the following parameters:

```
myswitch::display atmroute pnni> ptse [advanced] [<nodeix> [<orignodeid> [<ptseid>]]]
myswitch::display atmroute pnni> ptse advanced
Node OriginatingNodeId
                                                    PtseId
     80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00 1
                              SequenceNum Checksum LifeTime
     Type
                              5
     nodalInformation
                                         ca71
                                                 3599
         : 00 40 00 44 00 61 00 00 00 00 00 01 00 00 05
     16 : ca 71 0e 0f 00 61 00 30 47 00 05 80 ff el 00 00
     32 : 00 f2 lc lf 4e ff lc lf 4e 00 02 00 00 00 00
     Node OriginatingNodeId
     80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00 10000008
     Type
                              SequenceNum Checksum LifeTime
     horizontalLinks
                                        f217
                                                 3599
         : 00 40 00 bc 01 20 00 00 10 00 00 08 00 00 00 08
     16 : f2 17 0e 0f 01 20 00 a8 00 00 50 a0 47 00 05 80
     32 : ff el 00 00 00 f2 lc 10 42 ff lc 10 42 00 01 00
     48 : 10 00 00 03 10 00 00 08 00 00 00 00 00 80 00 20
     64 : 80 00 00 00 00 00 13 b0 00 05 63 b7 00 05 63 b5
     80 : 00 00 02 e9 00 00 02 d5 00 08 00 08 00 80 00 20
     96 : 40 00 00 00 00 00 13 b0 00 05 63 b7 00 05 63 b5
     112 : 00 00 02 e9 00 00 02 d5 00 08 00 08 00 80 00 20
     128 : 20 00 00 00 00 00 13 b0 00 05 63 b7 00 05 63 b5
Press return for more, q to quit: q
```

The fields in this display are defined in the same manner as in the previous example. If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> ptse
No ptse information is available
```

2.1.3.8 Displaying PNNI Spanning Tree Information

This command lets you display information about the computed spanning tree, which is used for Peer Group Leader (PGL) election. This tree shows reachability information for all of the nodes within a peer group. Enter the following parameters:

```
myswitch::> display amtroute pnni> stmap
Node MapNodeId
     80:160:47.000580ffe1000000f21c1f4e.ff1c1f4e0001.00
     ParentNodeId
                                                                     LinkType
                                                          Port
      80:160:47.000580ffe1000000f21c1042.ff1c10420001.00 0x10000003 hlink
Node MapNodeId
     80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00001.00
     ParentNodeId
                                                          Port
                                                                     LinkType
     80:160:47.000580ffe1000000f2lc1f4e.ff1c1f4e0001.00 0x10000020 hlink
Node MapNodeId
     80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00002.00
     ParentNodeId
                                                          Port
                                                                     LinkType
      80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00001.00 0x10000008 hlink
```

Field	Description
Node	The index number of the node to which the TDB (or root of the tree) belongs.
MapNodeId	The node identifier of a given node in the spanning tree.
ParentNodeId	The node identifier of the next hop node.
Port	The port identifier of the local port that connects to the next hop node.
LinkType	The type of link that connects this node to the remote node. Can be uplink or hlink (horizontal link).

You can also display information about a specific node, or a specific node and map node ID. Enter the following parameters to display information about a specific node and map node ID:

These fields in this display are defined in the same manner as in the previous example. If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> stmap
No spanning tree map information is available
```

2.1.4 Displaying the SPANS Topology

This menu lets you display the SPANS topology of the ATM network of which this switch is a part. Enter the following parameters to display the available command:

```
myswitch::display atmroute spans> ?
map
```

2.1.4.1 Displaying the SPANS Topology Map

This command displays the SPANS topology of the ATM network of which this switch is a part. All SPANS-NNI links appear in the topology. Enter the following parameters:

myswitch::display atmroute spans> map					
B Source	IPaddress	Destination	IPaddress	Capacity Ag	ge
1 f21a344a.e00000	01	f21a344a.e000000	1	0	3
1 f21a3596.e00000	01	f21a3596.e000000	1	0	5
1 f21a355f.02.0		f21a3596.02.0		149759	5
1 f21a3596.02.0		f21a355f.02.0		149759	3
1 f21a344a.08.0		f21a3445.08.0		149759	0

The fields in this display are defined as follows:

Field	Description
В	The number of the board (switch fabric).
Source	The source SPANS address of the link.
IPaddress	The IP address mapping to the source SPANS address, if known. Displays if it is unknown.
Destination	The destination SPANS address of the link.
IPaddress	The IP address mapping to the destination SPANS address, if known. Displays if it is unknown.
Capacity	The link capacity in Kbps. A negative value in this field indicates that the link has gone down, but it has not timed out yet.
Age	The age (freshness value) of the link. A value of -1 indicates that the link is invalidated, but has not timed out yet. The maximum freshness value is 200. All links age out at this point.

If this switch is not connected to any other *ForeRunner* or TNX switches that are using SPANS, then the following is displayed:

```
myswitch::display atmroute spans> map
No map information is available
```

CHAPTER 3

AMI Operation Commands

This chapter contains a detailed description of the AMI operation commands. The main operation menu can be found at the root level. There are several commands available under operation. Commands that are submenus are immediately followed by a ">" symbol. Typing? at the operation level displays these commands as follows:

3.1 Configuration Database (CDB) Commands

These commands allow you to manage the configuration database (CDB). Typing cdb? at the prompt at the operation level displays the cdb commands as follows:

myswitch::operation> cdb ?
backup init reset restore

3.1.1 Backing Up the CDB

This command lets you make a backup copy of the CDB either to a remote host or to the switch's FLASH memory. If you enter the <code>-ami</code> option, it lets you externalize your CDB as an AMI script file. Enter the following:

myswitch::operation cdb> backup [-ami] [[<host>:] <full path to backup file>]

These parameters are defined as follows:

Parameter	Description
ami	If specified, the CDB file is converted into an AMI command script file which can be used later to generate that configuration on the switch. This file is downloaded to the specified host. If a host or filename is not specified, the AMI command file is output to the console. Depending on size of your CDB, it takes about 2 to 5 minutes to output this file to the console. You cannot stop this output. See Section 3.1.1.1 in this manual for more information.
host	The IP address of the host to which the CDB or AMI command file will be backed up.
full path to backup file	The full path name of the file to which the CDB or AMI command file will be backed up.

If you configured the transfer protocol to be FTP using conf system protocol, you only need to enter the command shown above to perform the CDB backup. After you enter the command shown above, you are prompted for the remote userid and password of the remote host to which you are backing up the file.

If you configured the transfer protocol to be TFTP (this is the default) using conf system protocol, the remote host to which the file will be backed up must be running the TFTP server code. If you are unsure of how to do this, see the Installation and Maintenance manual for your switch.

If you are using TFTP to perform the CDB backup, you must first create an empty file in the /tftpboot directory on the remote host to receive the CDB. Use the touch command to do this. Then, use the chmod command to change the permissions of that file so that it will let the switch write the backup CDB to that file.

Perform the following steps to back up your CDB:

- 1. Telnet to your remote host and log in.
- 2. Enter the following commands in sequence:

cd /tftpboot
 touch <backup file name>
chmod 777 <backup file name>

- Exit from the telnet session.
- 4. Telnet to the switch and log into AMI.

5. Enter the following command:

```
oper cdb backup <host>:/tftpboot/<backup file name>
```

You should receive the following message:

```
CDB backup was successful
```

Your backup file now resides in the file and on the host you specified.

3.1.1.1 Externalizing the CDB Configuration

The -ami option allows you to convert the CDB file into an AMI command script file which generates the current configuration on the switch. You can look at your configuration and edit it. When you edit the externalized CDB file, it is an ASCII text script file which lists AMI commands that should run in a logical order.

Any commands that require the user's interaction for a response to a \mathbf{y}/\mathbf{n} prompt are executed with the default response of \mathbf{y} . However, any CDB configuration requests that require the switch to be rebooted or which prompt for a password are ignored, and are indicated with an error message. For example:

```
Line 37::configuration module traffic LC setmodel 1A 1
?ERROR: This command is not supported in non-interactive mode
```

In addition, the following commands and menus are not supported:

- · conf atmroute domain modify
- conf atmroute ftpnni border
- conf atmroute pnni policy new
- conf board clockscale
- conf fratm new
- conf funi new
- conf lane lec default mode
- · conf port j2 emptycells
- conf port traffic lc clp1 <port> UBR <number of cells>
- conf port traffic lc qsize
- conf port traffic le clp1 <port> UBR <number of cells>
- conf port traffic le qsize

- conf security login> (all commands in this menu)
- conf spans spvc new
- conf spvc pnni parameters reroute threshold
- conf switch callrecord password
- conf vpt new (extended qos options not supported)
- oper cdb> (all commands in this menu)
- oper env fabric temperature
- oper flash get
- · oper flash init
- oper flash put
- oper reboot
- · oper upgrade
- oper version

The externalized CDB file does not contain any of the default configuration information that can not be modified, such as UPC contract 0 and the default domain. However, it does contain all of the default configuration information that can be modified, such as VP 0 on all ports, the default signalling channel on each VP 0, etc. Since these paths and channels already exist on switch B, when you copy this CDB to switch B and attempt to execute it, the switch tries to execute the commands to create these paths and channels again.

Therefore, you must either delete all of these redundant commands before copying the file to switch B, or specify the -ignore_errors option when using oper cdb restore. If you do not use the -ignore_errors option and errors occur, the errors will cause the restore procedure to fail. If you use the -ignore_errors option and errors occur, you are notified of the errors. The restore procedure succeeds, but the commands that were in error do not succeed.

3.1.2 Initializing the CDB

This command lets you clear all permanent information from the CDB. The switch asks you to verify this action before it re-initializes the CDB. Enter the following parameters:

```
myswitch::operation cdb> init
This command will re-initialize the CDB and reboot the switch
Do you really want to remove ALL permanent information from
the database INCLUDING the configuration of all the network
interfaces? [n] n
myswitch::operation cdb>
```

3.1.3 Resetting the CDB

This command enables you to reset the CDB. The switch cautions you that all ATM information will be deleted. Information that is retained includes such things as the IP configuration, (the switch name and interface descriptions); the ATM routing protocol information, (domain and prefix information, etc.); password and userid information; and SecurID information. The switch then asks you to confirm that resetting the CDB is the desired action. Enter the following parameters:

```
myswitch::operation cdb> reset

********* W A R N I N G ********

This operation resets the switch configuration database.
As a result, the switch control software will be restarted.
You will lose connectivity with the switch while this operation is progressing.

Are you sure you want to reset the CDB [n]? n
myswitch::operation cdb>
```

If you enter yes to the reset question, the switch responds as follows:

```
Are you sure you want to reset the CDB [n]? y The switch will restart momentarily.
```

At this point, the switch resets the CDB, closes you out of all active sessions, and restarts the switch. You must then log in to AMI again to perform any more actions on the switch.

3.1.4 Restoring the Database

This command allows you to restore the switch CDB. Enter the following parameters:

swch::operation cdb> restore [-ami[-ignore_errors]] [<host>:]<full path to backup file>

These parameters are defined as follows:

Parameter	Description
ami	If specified, the AMI command file is downloaded and validated, and the commands are executed. This changes the current configuration on the switch according to that file. See Section 3.1.1.1 in this manual for more information.
ignore_errors	This option only applies to the AMI command file. If this option is not specified, and if errors occur during the validation or execution of the AMI commands, the execution of the rest of the script is aborted. This is the default action. If this option is specified, and if errors occur, then the rest of the script will continue. If the console is enabled, the errors are logged to the console. It is recommended that you specify this option.
host	The IP address of the host on which the CDB file that is to be restored resides.
full path to backup file	The full path name of the CDB file that is to be restored.

If you have configured the transfer protocol to be FTP using conf system protocol, you only need to enter the command shown above to perform the CDB restore. After you enter the command shown above, you are prompted for the remote userid and password of the remote host from which you are retrieving the file.

If you have configured the transfer protocol to be TFTP (this is the default) using conf system protocol, the remote host from which the file will be retrieved must be running the TFTP server code. If you are unsure of how to do this, see the Installation and Maintenance manual for your switch.

3.2 Environment Commands

These commands allow you to monitor the switch's environmental parameters. Type environment? at the prompt at the operation level to display the available commands:

myswitch::operation> environment ?
cpu fabric> fans power
temperature



The only environment command that is valid on an LE 155 is oper env cpu.

3.2.1 CPU Operation

This command lets you display information about the CPU(s). Enter the following:

myswitch::operation environment> cpu Type CpuStep State DRAMSize FlashSize BoardRev PromRev 1X p55 68 normal 67108864 8388608 1.0 p55 68 standby 67108864 8388608 Α 1.0

Field	Description
CPU	The slot in which the CPU resides. The number indicates in which switch fabric it resides (1 in an ASX-200BX, ASX-200WG, LE 155, or TNX-210, or 1, 2, 3, or 4 in an ASX-1000 or TNX-1100). The letter indicates in which of the two slots it resides. In an ASX-1000 or TNX-1100, \mathbf{x} is the top slot of the switch fabric. In an ASX-200BX, \mathbf{x} is the left slot of the switch fabric. In an ASX-1000 or TNX-1100, \mathbf{y} is the bottom slot of the switch fabric. In an ASX-200BX, \mathbf{y} is the right slot of the switch fabric.
Туре	The type of processor (i960ca, i960cf, i960ha, or p55).
CpuStep	The revision level of the CPU.
State	The current condition of the CPU. normal means this CPU is functioning properly and this CPU is the primary (controlling) CPU if more than one is installed. standby means this is the secondary (standby) SCP if more than one is installed. fail means something is wrong with this SCP.
DRAMSize	The amount of DRAM, in bytes, installed on the SCP board.
FlashSize	The size of FLASH, in bytes, installed on this SCP board.
BoardRev	The hardware revision level of the processor's board. ${\tt N/A}$ means the revision cannot be obtained; e.g., the other SCP is running a software version that does not support this field.
PromRev	The hardware revision level of the SCP PROM. This field is only available for SCPs that are HA or later. N/A means the revision cannot be obtained; e.g., the SCP is earlier than an HA or the other SCP is running a software version that does not support this field.

This command also lets you display the MAC address of the CPU(s). Enter the following:

```
myswitch::> operation environment> cpu ?
usage: cpu [-macaddr]

myswitch::> operation environment> cpu -macaddr
CPU Physical Address
1X 0020480f00bb
1Y 002048dedbef
```

Field	Description
СРИ	The slot in which the CPU resides. The number indicates in which switch fabric it resides (1 in an ASX-200BX, ASX-200WG, LE 155, or TNX-210, or 1, 2, 3, or 4 in an ASX-1000 or TNX-1100). The letter indicates in which of the two slots it resides. In an ASX-1000 or TNX-1100, \mathbf{x} is the top slot of the switch fabric. In an ASX-200BX, \mathbf{x} is the left slot of the switch fabric. In an ASX-1000 or TNX-1100, \mathbf{y} is the bottom slot of the switch fabric. In an ASX-200BX, \mathbf{x} is the right slot of the switch fabric.
Physical Address	This is the Ethernet MAC address of your SCP that is used during bootp. If you connect a terminal device to the SCP's serial port, you see the Ethernet MAC address displayed during the EPROM boot sequence. See Chapter 4 in the Installation and Maintenance manual for more information about bootp. The Ethernet MAC address also scrolls across the display LED on the SCP's front panel. See Chapter 4 in the Installation and Maintenance manual for more information about the display LED.

3.2.2 Switch Fabric Operation

These commands allow you to monitor the temperature of the individual switch fabrics on an ASX-1000 or TNX-1100 only. Typing fabric? at the prompt at the environment level to display the available commands as follows:

```
myswitch::operation environment> fabric ?
show temperature
```

3.2.3 Showing Switch Fabric Temperature Information

This command displays the current temperatures in degrees Celsius of each installed switch fabric on an ASX-1000 or TNX-1100, the current state of the temperature sensor, and the current thresholds at which a temperature alarm trips and then later resets. The current temperature and state values are displayed for all installed fabrics. Enter the following:

```
myswitch::operation environment fabric> show
Fabric
           Deg C
                      State
1
           31
                      normal
2
           28
                      normal
3
           37
                      normal
           35
                      normal
Alarm/trap reset threshold (this fabric): 60 degrees C or lower
Alarm/trap trip threshold (this fabric): 65 degrees C or greater
```

Field	Description	
Fabric	The number of the fabrics currently installed in the switch. Switch fabric 1 is in the slot labeled 1 on the enclosure, switch fabric 2 is in the slot labeled 2 on the enclosure, etc.	
Deg C	The current temperature of the switch fabrics in degrees Celsius.	
State	Shows overTemp if an alarm has been tripped because of this sensor, based on the trip and reset values that have been configured. Shows normal if otherwise, or if the alarm has reset.	
Alarm/trap reset threshold	The temperature in $^{\rm o}$ C at which an overtemperature alarm is reset. For example, if you set the reset and trip thresholds to 50 $^{\rm o}$ C and 60 $^{\rm o}$ C, respectively, then the alarm trips at 60 $^{\rm o}$ C, and is reset when the temperature drops back down to 50 $^{\rm o}$ C.	
Alarm/trap trip threshold	The temperature in $^{\rm o}$ C at which an overtemperature alarm trips. For example, if you set the reset and trip thresholds to 50 $^{\rm o}$ C and 60 $^{\rm o}$ C, respectively, the alarm trips at 60 $^{\rm o}$ C, and is reset when the temperature drops back down to 50 $^{\rm o}$ C.	

3.2.4 Configuring the Switch Fabric Temperature Thresholds

This command allows you to set the thresholds at which a temperature alarm is tripped and then later reset on an ASX-1000 or TNX-1100. Any temperature can cause the switch to display a state of normal or overTemp, depending on the trip and reset thresholds that you have set. For example, a temperature of 55 °C shows a state of normal if the trip threshold was 60 °C and the switch fabric temperature never reached 60 °C, but it would show a state of overTemp if the switch fabric temperature reached 60 °C, and then had dropped to 55 °C, but had not yet reached a reset threshold set at 50 °C. Enter the following:

myswitch::operation environment fabric> temperature <reset threshold> <trip threshold>

These parameters are defined as follows:

Parameter	Description
reset threshold	The temperature in °C at which an overtemperature alarm is reset. The default is 60 °C.
trip threshold	The temperature in °C at which an overtemperature alarm trips. The default is 65 °C.

3.2.5 Fan Operation

This command enables you to display information about the fans. On an ASX-1000 or TNX-1100, the following is displayed:

myswitch::operat	ion environment> fans
FanBank	FanBankState
1	normal
2	normal
3	normal
4	normal

Field	Description
FanBank	On an ASX-1000 or TNX-1100, this field corresponds to a single fan, indicating the number of the fan.
FanBankState	The current state of the fan. If the fan is functioning properly, it reads normal. If the fan has malfunctioned, it reads failed.

3.2.6 Power Supply Operation

This command lets you display information about power supplies. Enter the following to display information for an ASX-1000 with model A DC power supplies:

myswitch::ope	ration environme	nt> power			
PowerSupply	Type	InputState	OutputState	S/N	Version
1	ps48VDC	normal	normal	107	1
2	ps48VDC	normal	normal	195	1

This command lets you display information about power supplies. Enter the following to display information for an ASX-1000 or a TNX-1100 with model B DC power supplies:

mΣ	/SWI	itch::operation	n environmer	nt> power				
E	S	Type	InputState	OutputState	5VoltState	Current	S/N	Version
1	_	ps30ADC	normal	normal	normal	normal	10	1
2	2	ps30ADC	normal	normal	normal	normal	10	1

Enter the following to display information for an ASX-1000 with model A AC power supplies:

Enter the following to display information for an ASX-1000 or TNX-1100 with model B AC power supplies:

I	myswitchope	ration environmen	nt> power			
	PowerSupply	Type	InputState	OutputState	S/N	Version
	1	psRM1000HA	normal	normal	12	1
	2	psRM1000HA	normal	normal	22	1

Enter the following to display information about an ASX-200BX or TNX-210:

```
myswitch::> operation environment> power
PowerSupply Type InputState OutputState
1 psAutoRangeAC normal normal
2 psAutoRangeAC normal normal
```

Enter the following to display information about an ASX-200WG:

The following is displayed for environmental power on an LE 155:

```
myswitch::> operation environment> power
No environmental power information available
```

Field	Description
PowerSupply	On an ASX-200BX or TNX-210, 1 indicates the left power supply and 2 indicates the right power supply. On an ASX-1000 or TNX-1100, 1 indicates the power supply in slot 1 in the chassis and 2 indicates the power supply in slot 2 in the chassis, etc.
Туре	Shows whether it is an AC or a DC power supply.
InputState	Shows if the voltage coming into the power supply is normal or not.
OutputState	Shows if the voltage going out of the power supply is normal or not.
5VoltState	Shows the state of the +5V output of this power supply.
Current	Shows the state of the current on the input return path of this power supply.
S/N	Shows the serial number of the power supply.
Version	Shows the power supply's hardware version number.

3.2.7 Temperature Sensor Operation

This command enables you to display information gathered by the overtemperature sensors. Enter the following to display temperature information about an ASX-1000, or TNX-1100:

Enter the following to display temperature information about an ASX-200BX, ASX-200WG, LE 155, or a TNX-210:

Field	Description
TemperatureSensor ¹	Indicates where the temperature sensor is located on the unit.
SensorState	Shows if the temperature at the specified location is normal or not.

^{1.} Power supply temperature sensor information is only shown on an ASX-1000, or TNX-1100. If this command is issued on an ASX-200WG, ASX-200BX, LE 155, or on a TNX-210, information is shown only for the enclosure temperature sensor. No power supply temperature sensor information is displayed for these types of switches.

3.3 Panic Acknowledgment Commands

On a rare occasion, the SCP may go into a state called panic, in which it reboots, closes a user out of session, or goes into a hung or frozen state. When the SCP returns to a normal state and an active session is running again, the first thing you should do is execute the operation panic show AMI command to display information about what happened to the SCP when it panicked. This information helps FORE's Technical Support staff to diagnose the problem. Type panic? at the prompt at the operation level to display the panic commands as follows:

3.3.1 Setting the Panic Action

This command allows you to set the course of action that the SCP will take upon experiencing a panic condition. Enter the following:

```
myswitch::operation panic> action [(suspend | reboot)]
```

These parameters are defined as follows:

Parameter	Description
suspend	Indicates that the SCP will hang in a suspended state upon experiencing a panic. There is no panic record logged. This allows a way to perform debugging. It also provides a way to avoid the teardown of PVCs. PVCs are preserved so that you can choose a more convenient time for rebooting the system and restoring full functionality.
reboot	Indicates that the SCP will automatically reboot upon experiencing a panic. A panic record is logged. This is the default action.



It is highly recommended that you only use the **suspend** mode for diagnostic purposes. If **suspend** is the configured mode and the SCP panics, the SCP hangs until the user manually reboots the SCP. No automatic reboot will occur.

To display the action that is currently set, enter the following:

```
myswitch::operation panic> action
Current panic action is to reboot.
```

3.3.2 Clearing the Panic Flag

This command lets you clear the panic acknowledgment flag without viewing the contents of the panic dump file. Once the flag is cleared, you may return to normal operation of the switch.



Do not clear a panic condition until after you have performed the following three steps.

- 1. Use the operation panic show command in AMI to display the contents of the panic file.
- 2. Cut and paste this panic file information to another file on a host and save that file.
- 3. Send this information via e-mail to FORE's Technical Support along with a description of the events leading up to the panic. Ask the Technical Support staff to open a case for you based on that information. Once you have sent them the information, you may clear the panic record.

Enter the following parameters to clear a panic record on the controlling SCP:

```
myswitch::operation panic> clear
OK.
```

Enter the following parameters to clear a panic record on the standby SCP from the controlling SCP:

```
myswitch::operation panic> clear standby
OK.
```

The message below is shown when no panic record exists (i.e., the SCP has not experienced a panic condition).

```
myswitch::operation panic> clear
There is no panic condition to clear.
```

3.3.3 Displaying the Panic Dump File

This command lets you view the contents of the panic dump file, which contains information about what happened to the SCP when it panicked, without clearing the panic flag. This information can assist FORE's Technical Support staff in troubleshooting the cause of the panic. Once the flag is cleared, you may return to normal operation of the switch.

The following is an example of the kind of trace that appears on your console when a panic occurs:

```
Software version: 5.2.0 rev 1.14523 with 0 deltas
name:tWdTickle status:0x00000004 pri:0
edi:0000000000 esi:0x03e37e10 ebp:0x03e37dd0 esp:0x03e37dcc ebx:0000000000
edx:0000000000 ecx:0000000000 eax:0000000000 eflags:0x00000246 pc:0x00136212
0. 0x00136212
1. 0x0015c8b9
2. 0x0010aa99
3. 0x001703a8
name:tLogTask status:0x00000002 pri:1
edi:0xffffffff esi:0x03e3661c ebp:0x03e363fc esp:0x03e363f0 ebx:0000000000
edx:0000000000 ecx:0000000000 eax:0000000000 eflags:0x00000202 pc:0x00170ald
0. 0x00170ald
1. 0x00139592
2. 0x0015004c
3. 0x001703a8
03b52420: 00000000 00000002 00000001 ffffffff *.....*
03b52430: 03e3661c 03e363fc 03e363f0 00000000 *.f...c....*
03b52440: 00000000 00000000 00000000 00000202
                                              *....*
03b52450: 00170ald 00139592 0015004c 001703a8
                                              *....*
```



This example trace has been truncated. An actual trace would be much longer.

If you log in to AMI and enter the following, you can display the panic record:

```
myswitch::> oper panic show
name:tWdTickle status:0x00000004 pri:0
edi:0000000000 esi:0x03e37e10 ebp:0x03e37dd0 esp:0x03e37dcc ebx:0000000000
edx:0000000000 ecx:0000000000 eax:0000000000 eflags:0x000000246 pc:0x0013757a
0. 0x0013757a
1. 0x0015dc21
2. 0x0010ab09
3.0 \times 0.0171 d48
name:tLogTask status:0x00000002 pri:1
edi:0xffffffff esi:0x03e3661c ebp:0x03e363fc esp:0x03e363f0 ebx:0000000000
edx:0000000000 ecx:0000000000 eax:000000000 eflags:0x00000202 pc:0x001723bd
0.0 \times 0.01723 \text{bd}
1. 0x0013a8fa
2. 0x001513b4
3. 0x00171d48
Software version: 5.2.0 rev 1.14523 with 0 deltas
The panic dump is complete.
```

Once the information has been displayed, follow the steps listed in the previous subsection for clearing a panic record.

To display the panic information on a standby SCP, enter the following:

```
myswitch::operation panic> show standby
```

The following message is displayed whenever there is no panic record:

```
myswitch::operation panic> show
There is no panic dump to show you.
```



If the switch panics, the panic record is automatically written to syslog upon reboot, provided that a syslog host had been set prior to the panic. This is especially useful if multiple panics occur, so that each is separately recorded and is not overwritten as they are here. For more information about setting the syslog host, see the AMI Configuration Commands Reference Manual.

3.3.4 Saving the Panic File

This command lets you save the contents of the panic dump file, which contains information about what happened to the SCP when it panicked. When you use this command, the panic file is saved as an ASCII file in FLASH. To save the panic information on the primary SCP, enter the following:

```
myswitch::operation panic> save <filename>
```

For example:

```
myswitch::operation panic> save panic_myswitch_03_20_98
```

To save the panic information on the standby SCP, enter the following:

```
myswitch::operation panic> save <filename> standby
```

Once you have saved the file, you can transfer it to a host using the oper flash put command as follows:

```
myswitch::operation panic> up
myswitch::operation> flash
myswitch::operation flash> put panic_myswitch_03_20_98 172.122.18.14:
panic_myswitch_03_20_98
```

Once the file is on a host, you can either attach the panic file to an e-mail and send it, or print the file and fax it to FORE Systems' Technical Support. This information can assist FORE's Technical Support staff in troubleshooting the cause of the panic.

3.4 Series D Network Module Test Command

This command lets you perform various shared memory ASIC self-tests on Series D network modules only.



The tests take approximately five to ten minutes to finish.

Before you can test a Series D network module, you must first take it out of service by administering it down with the following AMI command:

myswitch::configuration module> admin <module> (up | down)

These parameters are defined as follows:

Parameter	Description	
module	The Series D network module that is to be administered up or down. Enter the board number and network module; e.g., $3A$.	
up down	up brings that network module back on-line. down causes the designated network module to be taken off-line temporarily so that it can be tested.	

For example, if you want to test module A on board 3, enter the following:

conf module admin 3A down

When this command is entered, a warning message is displayed as follows:

Disabling the network module will destroy all existing connections on the module. Disable the network module [n]? ${\bf y}$

Entering n or pressing **<enter**> aborts the command. Entering y tears down all of the existing connections and temporarily places the network module out of service. You can then test the network module using the following AMI command:

myswitch::operation module> test <module>

This parameter is defined as follows:

Parameter	Description
module	The Series D network module that is to be tested. Enter the board number and network module; e.g., 3A.

To test module A on switch fabric 3, enter the following:

```
oper module test 3A
```

You receive the following message:

```
Testing a network module may take 5-10 minutes

Start the test? [n]? y

Press the ENTER key to abort the test!!

Testing SRAM Bank 0.....

Testing SRAM Bank 1.....

DRAM........

Network module tests successful

Do you want to abort the tests [n]?
```

To abort the self-tests, press **<ENTER>** at any time during the test. You receive the following message:

```
Do you want to abort the tests [n]?
```

Entering **n** or pressing **<ENTER>** allows you to resume the tests. Entering **y** stops the tests. You receive the following message:

```
Abort the test [n]? Y
Network module test aborted.
```

When you are finished testing the network module, use the following command to put the network module back into service.

```
conf module admin 3A up
```

At that point, PVCs that are stored in the configuration database are re-established and SVCs are dynamically re-established.

3.5 Displaying and Setting the Date and Time

This command allows you to display the current date and time on the switch. To display this information, enter date at the operation level.

```
myswitch::operation> date
Dec 1 12:44:13 1997
```

This command also enables you to set the current date and time on the switch.



If you wish to set a time zone, you must set the time zone using the conf switch timezone command before setting the date and time.

To set or change this information, enter the following parameters:

```
myswitch::operation> date ?
myswitch::operation> date [gmt] [<mm>/<dd>/<yyyy> <hh>:<mm>:<ss>]
```

These parameters are defined as follows:

Parameter	Description	
mm/dd/yyyy	The current date ¹ . Enter the month, the day, and the year numerically; e.g., 5/10/1997. The year must be four digits long, the month must be between 1-12, and the day must be between 1-31.	
gmt	Specifying gmt displays the Greenwich Mean Time (GMT) corresponding to the local time; e.g., if your time zone is EST5EDT and oper date shows Oct 14 12:44:13 1997, then oper date gmt would show Oct 14 17:44:13 1997.	
hh:mm:ss	The current local time. Enter the hour (in terms of a 24-hour clock; i.e., 1:00 pm is 13), the minutes, and the seconds. The hour must be between 0-23, the minutes must be between 0-59, and the seconds must be between 0-59. For example, to set the time as 2:02 pm, enter 14:02:00.	

^{1.} The date can not be set prior to May 24, 1994, and the date can not be set past January 18, 2038.



Ensure that the switch time and date are set correctly before enabling the call recording functionality using conf switch callrecord enable cr. Otherwise, your call records will not be accurate.

3.6 FLASH Operation Commands

These commands enable management of the FLASH memory system. Typing flash? at the prompt at the operation level displays the flash commands as follows:

3.6.1 Copying a File to FLASH Memory

This command allows you to copy a file within the FLASH memory system. Enter the following parameters:

```
myswitch::operation flash> copy <from> <to>
```

These parameters are defined as follows:

Parameter	Description		
from	The file to be copied.		
to	The file within the FLASH memory system to which the first file is copied.		

3.6.2 Deleting a File from FLASH Memory

This command allows you to delete a file from the FLASH memory system. Enter the following parameters:

```
myswitch::operation flash> delete <file>
```

This parameter is defined as follows:

Parameter	Description	
file	The file within the FLASH memory system that is to be deleted.	

In order to delete a directory from the FLASH memory system (e.g., FT5.2/), you must first delete all files in that directory. For example, list all directories in your FLASH memory system as follows:

```
myswitch::operation flash> dir
LECS.CFG
FT5.2/
CURRENT
```

Then list all files in the directory that you want to delete as follows:

```
myswitch::operation flash> dir ft5.2
FOREOS.EXE
```

Now delete the file in the directory as follows:

```
myswitch::operation flash> del ft5.2/foreos.exe
```

Now you can delete the directory as follows:

```
myswitch::operation flash> del ft5.2
```

3.6.3 Displaying the FLASH Memory Directory

This command enables you to display the directory listing of the FLASH memory system. Enter the following parameters:

```
myswitch::operation flash> dir
LECS.CFG
FT5.2/
CURRENT
```

3.6.4 Displaying Free Space on the FLASH File

This command lets you display the amount of remaining free space in the FLASH memory system. Enter the following parameters:

```
myswitch::operation flash> free
There are 1891974 bytes of flash still available
```



Depending on the condition of the FLASH file system, it may take several minutes for this command to complete.

3.6.5 Getting a FLASH File

This command lets you retrieve a file from a remote host. Enter the following parameters:

```
myswitch::operation flash> get <host:remotefile> <localfile>
```

These parameters are defined as follows:

Parameter	Description		
host:remotefile	The IP address of the host and file from which the file is to be retrieved.		
localfile	The name of the FLASH file where the retrieved file is to be stored.		

If you have configured the transfer protocol to be FTP using conf system protocol, you only need to enter the command shown above to perform the FLASH file restore. After you enter the command shown above, you are prompted for the remote userid and password of the remote host from which you are retrieving the file.

If you have configured the transfer protocol to be TFTP (this is the default) using conf system protocol, the remote host from which the FLASH file will be retrieved must be running the TFTP server code. If you are unsure of how to do this, see the Installation and Maintenance manual for your switch.

3.6.6 Initializing the FLASH File

This command lets you initialize the FLASH file.

CAUTION



Initializing the FLASH file deletes <u>all</u> information from the FLASH file, including the switch software, except the CDB, which is written back.

Because this action results in the removal of data, the switch asks you to verify this action before it re-initializes the FLASH file. Enter the following parameters:

```
myswitch::operation flash> init
Are you sure you want to format the flash [n]? n
myswitch::operation flash>
```

3.6.7 Putting a FLASH File on a Remote Host

This command allows you to copy a FLASH file to a remote host. Enter the following:

```
myswitch::operation flash> put <localfile> <host:remotefile>
```

These parameters are defined as follows:

Parameter	Description		
localfile	The name of the FLASH file to be copied.		
host:remotefile	The IP address of the host and file to which the FLASH file is to be copied.		

If you have configured the transfer protocol to be FTP using conf system protocol, you only need to enter the command shown above to perform the FLASH backup. After you enter the command shown above, you are prompted for the remote userid and password of the remote host to which you are backing up the FLASH file.

If you have configured the transfer protocol to be TFTP (this is the default) using conf system protocol, the remote host to which the FLASH file will be backed up must be running the TFTP server code. If you are unsure of how to do this, see the Installation and Maintenance manual for your switch.

If you are using TFTP to perform the FLASH file backup, you must first create an empty file in the /tftpboot directory on the remote host to receive the FLASH file. Use the touch command to do this. Then, use the chmod command to change the permissions of that file so that it will let the switch write the backup FLASH to that file.

Perform the following steps to back up your FLASH:

- 1. First, telnet to your remote host and log in.
- 2. Enter the following commands in sequence:

cd /tftpboot
touch <backup file name>
chmod 777 <backup file name>

- 3. Then exit from the telnet session.
- 4. Telnet to the switch and log into AMI.
- 5. Enter the following command:

```
oper flash put <host>:/tftpboot/<backup file name>
```

You should receive a confirmation message that the FLASH file was successfully copied.

3.6.8 Renaming a FLASH File

This command enables you to rename a file that is in FLASH memory. Enter the following parameters:

myswitch::operation flash> rename <from> <to>

These parameters are defined as follows:

Parameter	Description	
from	The current name of the file to be renamed.	
to	The new name of the file to be renamed.	

3.7 Upgrading the Switch

This command allows you to upgrade the software on an individual SCP.



If you want to upgrade the software on an ASX-1000 or TNX-1100 or on both SCPs in an ASX-200BX or TNX-210, you must perform the upgrade on each SCP individually.

You can get to this level by entering upgrade at the operation level. Enter the following parameters:



For complete instructions about performing a software upgrade, see the Installation and Maintenance manual for your switch.

myswitch::operation> upgrade <remotehost>:<full path to remotefile>

These parameters are defined as follows:

Parameter	Description	
remotehost	The IP address of the remote host on which the upgrade file resides	
full path to remotefile	The full path name of the upgrade file.	

If you have configured the transfer protocol to be FTP using conf system protocol, you are prompted for the remote userid and password of the remote host from which you are retrieving the file. For example:

```
myswitch::operation> upgrade <remotehost>:<full path to remotefile>
  Will upgrade directly to flash
  remote userid: <remote userid>
  remote password: <remote password>
```

If you have configured the transfer protocol to be TFTP (this is the default) using <code>conf system protocol</code>, the remote host on which the upgrade file resides must be a tftpboot server. To perform the initial switch software upgrade successfully using TFTP, the bootp server and the tftpboot server must be configured properly. If you are unsure of how to do this, see the Installation and Maintenance manual for your switch.

3.8 Displaying and Changing the Version of Software

This command allows you to display and/or change the version of software that is currently running on the SCP. To display the current version, enter the following parameters:

```
myswitch::operation> version
Software versions installed: FT5.2
Current software version is FT5.2
```

If more than one version is installed, you can type the following parameters to change the current version:

```
myswitch::operation> version [<new-version>]
```

This parameter is defined as follows:

Parameter	Description
new-version	The name of the software version with which you want to replace the current version.

ForeThought 5.2.x automatically imports configuration information when upgrading an ASX, TNX, or ForeRunnerLE switch from ForeThought 5.0.x or ForeThought 5.1.x. To upgrade from one of the earlier ForeThought releases listed here, you should back up your CDB (using AMI command oper cdb backup), and then upgrade directly to 5.2.x (using oper upgrade).

Downgrades, however, do not automatically export configuration information to the earlier version. You will only be able access the switch through the serial port. The FLASH is reformatted during this process.

If you absolutely need to downgrade a switch, you <u>must</u> perform the following steps on a console connected to the serial port:

- Back up the CDB of the switch running ForeThought 5.2.x (using oper cdb backup).
- 2. Downgrade to ForeThought 5.0.x or ForeThought 5.1.x (using oper upgrade) and reboot the switch.
- Perform a FLASH init (using oper flash init).
- If needed, re-assign the IP address and default route information, and reboot over Ethernet.

- 5. Perform an oper upgrade again of the older version, but DO NOT reboot the switch.
- 6. Restore the CDB (using oper cdb restore) and reboot the switch.

If you have any questions about changing between software versions, contact FORE Systems' Technical Support.



For complete instructions about changing between multiple versions of software, see the Installation and Maintenance manual for your switch.

3.9 Rebooting the Switch

This command enables you to reboot the SCP. You can get to this level by entering reboot at the operation level. You are asked to verify that you want to take this action. Enter the following parameters:

```
myswitch::operation> reboot
Are you sure you want to reboot this switch [n]? y
```

Upon reboot, the SCP immediately closes you out of all open AMI sessions.

CHAPTER 4

AMI Statistics Commands

This chapter contains a detailed description of the AMI statistics commands that display operational performance and error information for the various hardware and software features of the switch and the network modules. The main statistics menu can be found at the root level. To display the available commands, type? at the statistics level as follows:

myswitch::statistics	> ?		
aal0	aal4	aal5	atm
atmroute>	board	cec>	cese1
cesds1	ces	cr	ctlport
fratm>	funi>	icmp	interface
ip	ipaccess	iwf>	module
nsapfilter>	oam>	port	spans
tcp	udp	signalling	VCC
vpc	vpt		

Each of these commands is described in the following subsections.

4.1 AAL0 Statistics

You can display AALO statistics for an individual switch fabric by entering **aalO** at the statistics level as follows:

myswitch::statistics>	aa10		
Interface	XmtCell	RcvCell	CellDsc
asx0	0	0	0
qaa0	0	0	0
qaa1	0	0	0
qaa2	0	0	0
gaa3	0	0	0

Field	Description
Interface	The AAL0 interface.
XmtCell	The number of transmitted cells.
RcvCell	The number of received cells.
CellDsc	The number of discarded cells.

4.2 AAL4 Statistics

You can display AAL4 statistics for an individual switch fabric by entering **aal4** at the statistics level as follows:

myswitch	::statistic	s> aal4						
Intfce	XmtCell	RcvCell	XmtPDU	RcvPDU	CRCErrs	SARErrs	CSErrs	CellDsc
asx0	120617	27227	46.8M	9.6M	0	0	0	0.0K
qaa0	120617	27227	46.8M	9.6M	0	0	0	0.0K
qaa1	120617	27227	46.8M	9.6M	0	0	0	0.0K
qaa2	120617	27227	46.8M	9.6M	0	0	0	0.0K
qaa3	120628	27229	46.8M	9.6M	0	0	0	0.0K

Field	Description
Intfce	The AAL4 interface.
XmtCell	The number of transmitted cells.
RcvCell	The number of received cells.
XmtPDU	The number of PDU packets transmitted.
RcvPDU	The number of PDU packets received.
CRCErrs	The number of CRC errors.
SARErrs	The number of segmentation and reassembly errors.
CSErrs	The number of convergence sublayer errors.
CellDsc	The number of discarded cells.

4.3 AAL5 Statistics

You can display AAL5 statistics for an individual switch fabric. This display shows both cell and packet counts to the IP interfaces on the switch control processor (SCP). Run this command several times successively and note the increases in the XmtCell and RcvCell fields, which indicate the traffic flow in the SCP. Enter aal5 at the statistics level as follows:

myswitch:	:statistics	s> aal5						
Intfce	XmtCell	RcvCell	XmtPDU	RcvPDU	CRCErrs	CSErrs (CellDsc	PDUDsc
asx0	279848	214912	49.5M	32.8M	2	0	18.7K	0
qaa0	279848	214913	49.5M	32.8M	2	0	18.7K	0
qaa1	279848	214913	49.5M	32.8M	2	0	18.7K	0
qaa2	279848	214915	49.5M	32.8M	2	0	18.7K	0
gaa3	279848	214915	49.5M	32.8M	2	0	18.7K	0

Field	Description
Intfce	The AAL5 interface.
XmtCell	The number of transmitted cells.
RcvCell	The number of received cells.
XmtPDU	The number of PDU packets transmitted.
RcvPDU	The number of PDU packets received.
CRCErrs	The number of CRC errors.
CSErrs	The number of convergence sublayer errors.
CellDsc	The number of discarded cells.
PDUDsc	The number of discarded PDU packets.

4.4 ATM Statistics

You can display ATM statistics for an individual switch fabric. This displays shows cell count and counts of invalid VPI/VCI values received by the SCP. Enter atm at the statistics level as follows:

myswitch::s	statistics>	atm				
Interface	XmtCell	RcvCell	VPI-OOR	VPI-Noc	VCI-OOR	VCI-Noc
asx0	23162276	21187910	0	0	0	1
qaa0	23162276	21187911	0	0	0	1
qaa1	23162276	21187912	0	0	0	1
qaa2	23162287	21187913	0	0	0	1
qaa3	23162287	21187914	0	0	0	1

Field	Description
Interface	The ATM interface.
XmtCell	The number of transmitted cells.
RcvCell	The number of received cells.
VPI-OOR	The number of VPIs out of range.
VPI-Noc	The number of VPIs with no connection which means that there is no mapping entry listed for them.
VCI-OOR	The number of VCIs out of range.
VCI-Noc	The number of VCIs with no connection which means that there is no mapping entry listed for them.

4.5 ATM Route Statistics

These commands let you display PNNI routing statistics on an individual switch fabric. Enter ? at the statistics atmroute level to list the following submenu:

```
myswitch::statistics atmroute> ?
pnni>
```

4.5.1 PNNI Routing Statistics

These commands let you display PNNI routing statistics on an individual switch fabric. Enter ? at the pnni level to list the following commands:

```
myswitch::statistics atmroute pnni> ?
  link     peer     profile     sc
```

4.5.1.1 PNNI Link Statistics

This command lets you display counters for PNNI links. These counters show the number of hello, or "keep alive," messages exchanged by neighboring nodes. Enter the following:

```
      myswitch::statistics atmroute pnni> link

      Node
      Port
      VPI
      PortId
      RcvHellos
      XmtHellos

      1
      3A4
      0
      10000003
      38
      38

      1
      3E1
      0
      10000020
      0
      306

      1
      3E2
      0
      10000021
      0
      309

      1
      3E4
      0
      10000023
      0
      308
```

Field	Description
Node	The index number of the node to which the displayed link is attached.
Port	The port through which the link is attached to the node.
VPI	The virtual path number on the port on which the PNNI hello protocol is running.
PortId	The PNNI port identifier for this link.
RcvHellos	The number of hello messages this node received from the neighbor attached to this node on this interface.
XmtHellos	The number of hello messages this node sent to the neighbor attached to it on this interface.

You can also display link statistics for a specific node, port, and path as follows:

```
myswitch::statistics atmroute pnni> link [<nodeix> [<port> <vpi>]]
myswitch::statistics atmroute pnni> link 1 3A4 0
Node Port VPI PortId RcvHellos XmtHellos
1 3A4 0 10000003 38 38
```

The fields in this display are defined in the same manner as in the previous example.

If PNNI has not been configured on this fabric or if there are no PNNI links attached to this switch, then the following is displayed:

```
myswitch::statistics atmroute pnni> link
No link information is available
```

4.5.1.2 PNNI Peer Statistics

This command lets you display counters for PNNI peers. These counters show the numbers of different types of messages exchanged by the peers as part of the database exchange protocol. Enter the following parameters:

```
myswitch::statistics atmroute pnni> peer
Node PeerNodeId

1  80:160:47.000580ffe1000000f21c1f4e.ff1c1f4e0001.00
PortCount RcvDbsums XmtDbsums RcvPtsps XmtPtsps RcvPtseReqs XmtPtseReqs
1  2  3  5  5  2  2
RcvPtseAcks XmtPtseAcks
3  2
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the local node.
PeerNodeId	The node identifier of the peer node.
PortCount	The number of ports connected to the specified peer node. Also, shows the number of hello protocols running between the two peers.
RcvDbsums	The number of database summary packets received from the peer node.
XmtDbsums	The number of database summary packets sent by this node.
RcvPtsps	The number of PNNI Topology State Packets (PTSPs) received from the peer node.
XmtPtsps	The number of PTSPs sent by this node.
RcvPtseReqs	The number of PNNI Topology State Element (PTSE) request packets received from the peer node.
XmtPtseReqs	The number of PTSE request packets sent by this node.
RcvPtseAcks	The number of PTSE acknowledgment packets received from the peer node.
XmtPtseAcks	The number of PTSE acknowledgment packets sent by this node.

You can also display peer statistics for a specific node or peer as follows:

```
myswitch::statistics atmroute pnni> peer [<nodeix> [<rmtnodeid>]]
```

If PNNI has not been configured on this fabric or if this node has no peers (neighbors), then the following is displayed:

```
myswitch::statistics atmroute pnni> peer
No peer information is available
```

4.5.1.3 PNNI Profile Usage Statistics

This command lets you display the number of times that a precomputed path defined by a profile is used. Enter the following parameters:

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node with which this profile is associated.
Profile	The profile number to which the counter belongs.
Hits	The number of times the precomputed path defined by the profile has been used.
TimeSinceLastHit	The amount of time since the precomputed path defined by the profile has been used.

You can also display profile statistics for a specific node or profile as follows:

```
myswitch::statistics atmroute pnni> profile [<nodeix> [profix>]]
myswitch::statistics atmroute pnni> profile 1 10
Node Profile NumberOfHits TimeSinceLastHit
1 10 5 0d 00:45:47
```

If PNNI has not been configured on this fabric or if you have not configured any profiles, then the following is displayed:

```
myswitch::statistics atmroute pnni> profile
No profile information is available
```

4.5.1.4 Scheduler Statistics

This command lets you display the counters in a scheduler. These counters show the load on the switch and the switch's ability to handle PNNI routing messages. Enter the following:

```
myswitch::statistics atmroute pnni> sc

Node Events Purges TimeoutPurges PacketsDropped HiPriPktsDropped
1 216 48 48 0 0 0

LowPriPktsDropped NodalInfoEvents HorizLinkEvents
0 43 173

UplinkEvents NodalStateEvents
0 0
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node.
Events	The number of scheduler events.
Purges	The number of purges.
TimeoutPurges	The number of time-out purges.
PacketsDropped	The number of packets dropped.
HiPriPktsDropped	The number of high priority packets dropped.
LowPriPktsDropped	The number of low priority packets dropped.
NodalInfoEvents	The number of events related to changes in attributes of nodes in the network.
HorizLinkEvents	The number of events related to changes in attributes of links in the network.
UplinkEvents	The number of events related to changes in attributes of uplinks in the network (if the node is part of a hierarchical PNNI network).
NodalStateEvents	The number of events related to changes in attributes of nodal state in the network (if the node is part of a hierarchical PNNI network).

You can also display scheduler statistics for a specific node as follows:

```
myswitch::statistics atmroute pnni> sc [<nodeix>]
```

If PNNI has not been configured on this fabric, then the following is displayed:

```
myswitch::statistics atmroute pnni> sc
No scheduler information is available
```

4.6 Switch Board Statistics

You can display switch board statistics for an individual switch board by entering board at the statistics level as follows:

Field	Description	
Board	The board (switch fabric number).	
VPI-Lookup-Errors	The number of cells that do not match any VPI lookup tables.	
VCI-Lookup-Errors	The number of cells that do not match any VCI lookup tables.	

4.7 CEC Statistics

This section contains a detailed description of the statistics commands that display operational performance and error information received by the CEC-Plus. The cec statistics menu is available at the main statistics menu.

```
myswitch::statistics> cec
```

To display the cec commands, a TCM must be installed in the switch and a TCM (the one in slot X or slot Y) must be selected. To select the TCM in slot X (the top slot), type slotx at the cec sublevel. To select the TCM in slot Y (the bottom slot), type sloty at the cec sublevel.

```
myswitch::statistics cec> slotx
```

After selecting a TCM, type ? to display the available commands, as follows:

Each of these commands is described in the following subsections. The commands for both slotx and sloty are the same, but they are only described once with examples that read slotx.

4.7.1 ICMP Statistics

You can list ICMP statistics for the interfaces by entering icmp at the sloty level as follows:

myswitch::statistics cec slotx> icmp			
Value	Delta		
1	0		
0	0		
1	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
1	0		
1	0		
1	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
	Value 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		

Field	Description
ecpIcmpInMsgs	The total number of ICMP messages which the entity received. This counter includes all those counted by icmpInErrors.
ecpIcmpInErrors	The number of ICMP messages which the entity received but determined as having ICMP-specific errors (bad ICMP checksums, bad length, etc.).
ecpIcmpInDestUnreachs	The number of ICMP Destination Unreachable messages received.

Field	Description
ecpIcmpInTimeExcds	The number of ICMP Time Exceeded messages received.
ecpIcmpInParmProbs	The number of ICMP Parameter Problem messages received.
ecpIcmpInSrcQuenchs	The number of ICMP Source Quench messages received.
ecpIcmpInRedirects	The number of ICMP Redirect messages received.
ecpIcmpInEchos	The number of ICMP Echo (request) messages received.
ecpIcmpInEchoReps	The number of ICMP Echo Reply messages received.
ecpIcmpInTimestamps	The number of ICMP Timestamp (request) messages received.
ecpIcmpInTimestampReps	The number of ICMP Timestamp Reply messages received.
ecpIcmpInAddrMasks	The number of ICMP Address Mask Request messages received.
ecpIcmpInAddrMaskReps	The number of ICMP Address Mask Reply messages received.
ecpIcmpOutMsgs	The total number of ICMP messages which this entity attempted to send. This counter includes all those counted by icmpOutErrors.
ecpIcmpOutErrors	The number of ICMP messages which this entity did not send due to problems discovered within ICMP such as a lack of buffers. This value should not include errors discovered outside the ICMP layer such as the inability of IP to route the resultant datagram. In some implementations there may be no types of error which contribute to this counter's value.
ecpIcmpOutDestUnreachs	The number of ICMP Destination Unreachable messages sent.
ecpIcmpOutTimeExcds	The number of ICMP Time Exceeded messages sent.
ecpIcmpOutParmProbs	The number of ICMP Parameter Problem messages sent.
ecpIcmpOutSrcQuenchs	The number of ICMP Source Quench messages sent.
ecpIcmpOutRedirects	The number of ICMP Redirect messages sent. For a host, this object is always zero, since hosts do not send redirects.
ecpIcmpOutEchos	The number of ICMP Echo (request) messages sent.
ecpIcmpOutEchoReps	The number of ICMP Echo Reply messages sent.
ecpIcmpOutTimestamps	The number of ICMP Timestamp (request) messages sent.
ecpIcmpOutTimestampReps	The number of ICMP Timestamp Reply messages sent.
ecpIcmpOutAddrMasks	The number of ICMP Address Mask Request messages sent.
ecpIcmpOutAddrMaskReps	The number of ICMP Address Mask Reply messages sent.



The value column displays the current value of the counter. The delta column displays the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.7.2 Interface Statistics

You can list interface statistics for the TCM by entering interface at the slotx or sloty level as follows:

myswitch::statistics cec slotx	<pre>interface</pre>		
Interface ie0 Counter	Value	Delta	
ecpNetIfInOctets	4294967295		0
ecpNetIfInUcastPkts	4980		0
ecpNetIfInNUcastPkts	0		0
ecpNetIfInDiscards	0		0
ecpNetIfInErrors	0		0
ecpNetIfInUnknownProtos	0		0
ecpNetIfOutOctets	4294967295		0
ecpNetIfOutUcastPkts	1549		0
ecpNetIfOutNUcastPkts	0		0
ecpNetIfOutDiscards	0		0
ecpNetIfOutErrors	1		0
ecpNetIfOutQLen	0		0
Press return for more, q to qu	uit: q		

Field	Description
ecpNetIfInOctets	The total number of octets received on the interface, including framing characters.
ecpNetIfInUcastPkts	The number of subnetwork-unicast packets delivered to a higher-layer protocol.
ecpNetIfInNUcastPkts	The number of non-unicast (i.e., subnetwork-broadcast or subnetwork-multicast) packets delivered to a higher-layer protocol.
ecpNetIfInDiscards	The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
ecpNetIfInErrors	The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
ecpNetIfInUnknownProtos	The number of packets received via the interface which were discarded because of an unknown or unsupported protocol.
ecpNetIfOutOctets	The total number of octets transmitted out of the interface, including framing characters.
ecpNetIfOutUcastPkts	The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.

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Field	Description
ecpNetIfOutNUcastPkts	The total number of packets that higher-level protocols requested be transmitted to a non-unicast (i.e., a subnetwork-broadcast or subnetwork-multicast) address, including those that were discarded or not sent.
ecpNetIfOutDiscards	The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
ecpNetIfOutErrors	The number of outbound packets that could not be transmitted because of errors.
ecpNetIfOutQLen	The length of the output packet queue (in packets).



The value column displays the current value of the counter. The delta column displays the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.7.3 IP Statistics

You can display IP statistics for the TCM by entering ip at the slotx or sloty level as follows:

myswitch::statistics cec slotx> ip			
ip Counter	Value	Delta	
ecpIpInReceives	4546		0
ecpIpInHdrErrors	0		0
ecpIpInAddrErrors	2		0
ecpIpForwDatagrams	0		0
ecpIpInUnknownProtos	1		0
ecpIpInDiscards	0		0
ecpIpInDelivers	3443		0
ecpIpOutRequests	1655		0
ecpIpOutDiscards	0		0
ecpIpOutNoRoutes	0		0
ecpIpReasmReqds	220		0
ecpIpReasmOKs	220		0
ecpIpReasmFails	0		0
ecpIpFragOKs	0		0
ecpIpFragFails	0		0
ecpIpFragCreates	0		0

Field	Description
ecpIpInReceives	The total number of input datagrams received from interfaces, including those received in error.
ecpIpInHdrErrors	The number of input datagrams discarded due to errors in their IP headers, including bad checksums, version number mismatch, other format errors, time-to-live exceeded, errors discovered in processing their IP options, etc.
ecpIpInAddrErrors	The number of input datagrams discarded because the IP address in their IP header's destination field was not a valid address to be received at this entity. This includes invalid addresses (e.g., 0.0.0.0) and addresses of unsupported Classes (e.g., Class E). For entities which are not IP Gateways and, therefore, do not forward datagrams, this includes datagrams discarded because the destination address was not local.
ecpIpForwDatagrams	The number of input datagrams for which this entity was not their final IP destination, as a result of which an attempt was made to find a route to forward them to that final destination. In entities which do not act as IP Gateways, this counter includes only those packets which were Source-Routed via this entity, and the Source-Route option processing was successful.

Field	Description
ecpIpInUnknownProtos	The number of locally-addressed datagrams received successfully but discarded because of an unknown or unsupported protocol.
ecpIpInDiscards	The number of input IP datagrams for which no problems were encountered to prevent their continued processing, but which were discarded (e.g., for lack of buffer space). This counter does not include any datagrams discarded while awaiting re-assembly.
ecpIpInDelivers	The total number of input datagrams successfully delivered to IP user-protocols (including ICMP).
ecpIpOutRequests	The total number of IP datagrams which local IP user-protocols (including ICMP) supplied to IP in requests for transmission. This counter does not include datagrams counted in ipForwDatagrams.
ecpIpOutDiscards	The number of output IP datagrams for which no problem was encountered to prevent their transmission to their destination, but which were discarded (e.g., for lack of buffer space). This counter includes datagrams counted in ipForwDatagrams if any such packets met this (discretionary) discard criterion.
ecpIpOutNoRoutes	The number of IP datagrams discarded because no route could be found to transmit them to their destination. This counter includes any packets counted in ipForwDatagrams which meet this "no-route" criterion. This includes datagrams which a host cannot route because all of its default gateways are down.
ecpIpReasmReqds	The maximum number of seconds which received fragments are held while they are awaiting reassembly at this entity.
ecpIpReasmOKs	The number of IP datagrams successfully reassembled.
ecpIpReasmFails	The number of failures detected by the IP reassembly algorithm (for whatever reason: timed out, errors, etc). This is not necessarily a count of discarded IP fragments since some algorithms (notably the algorithm in RFC-815) can lose track of the number of fragments by combining them as they are received.
ecpIpFragOKs	The number of IP datagrams that have been successfully fragmented at this entity.
ecpIpFragFails	The number of IP datagrams that have been discarded because they needed to be fragmented at this entity but could not be; e.g., because their Don't Fragment flag was set.
ecpIpFragCreates	The number of IP datagram fragments that have been generated as a result of fragmentation at this entity.



The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked it. The counters are reset when the switch is restarted.

4.7.4 TCP Statistics

You can display TCP statistics for the TCM by entering tcp at the slotx or sloty level as follows:

myswitch::statistics cec slotx> tcp			
tcp Counter	Value	Delta	
ecpTcpActiveOpens	1	0	
ecpTcpPassiveOpens	3	0	
ecpTcpAttemptFails	1	0	
ecpTcpEstabResets	0	0	
ecpTcpCurrEstab	1	0	
ecpTcpInSegs	2183	20	
ecpTcpOutSegs	1276	14	
ecpTcpRetransSegs	2	0	

The fields in this display are defined as follows:

Field	Description
ecpTcpActiveOpens	The number of times TCP connections have made a direct transition to the SYN-SENT state from the CLOSED state.
ecpTcpPassiveOpens	The number of times TCP connections have made a direct transition to the SYN-RCVD state from the LISTEN state.
ecpTcpAttemptFails	The number of times TCP connections have made a direct transition to the CLOSED state from either the SYN-SENT state or the SYN-RCVD state, plus the number of times TCP connections have made a direct transition to the LISTEN state from the SYN-RCVD state.
ecpTcpEstabResets	The number of times TCP connections have made a direct transition to the CLOSED state from either the ESTABLISHED state or the CLOSE-WAIT state.
ecpTcpCurrEstab	The number of TCP connections for which the current state is either ESTABLISHED or CLOSE- WAIT.
ecpTcpInSegs	The total number of segments received, including those received in error. This count includes segments received on currently established connections.
ecpTcpOutSegs	The total number of segments sent, including those on current connections but excluding those containing only retransmitted octets.
ecpTcpRetransSegs	The total number of segments retransmitted; i.e., the number of TCP segments transmitted containing one or more previously transmitted octets.



The value column displays the current value of the counter. The delta column displays the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.7.5 UDP Statistics

You can display UDP statistics for the TCM by entering udp at the slotx or sloty level as follows:

myswitch::statistics cec slotx> udp			
udp Counter	Value	Delta	
ecpUdpInDatagrams	0	0	
ecpUdpNoPorts	0	0	
ecpUdpInErrors	0	0	
ecpUdpOutDatagrams	0		

The fields in this display are defined as follows:

Field	Description
ecpUdpInDatagrams	The total number of UDP datagrams delivered to UDP users.
ecpUdpNoPorts	The total number of received UDP datagrams for which there was no application at the destination port.
ecpUdpInErrors	The number of received UDP datagrams that could not be delivered for reasons other than the lack of an application at the destination port.
ecpUdpOutDatagrams	The total number of UDP datagrams sent from this entity.



The value column displays the current value of the counter. The delta column displays the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.8 E1 CES Statistics

To view statistics for E1 CES ports, enter the following at the statistics level:

myswit	tch::sta	atis	tics> (cese1								
Curre	nt Stati	isti	CS									
Port	ES	SES	SEF	UAS	CSS	PCV	LES	BES	DM	LCV		
3C1	0	0	0	0	0	0	0	0	0	0		
Total	Statist	cics										
Port	ES	SES	SEF	UAS	CSS	PCV	LES	BES	DM	LCV		
3C1	0	0	0	0	0	0	0	0	0	0		
Interv	val Stat	ist:	ics									
Port	Interva	al	ES	SES	SEF	UAS	CSS	PCV	LES	BES	DM	LCV
3C1		1	0	0	0	0	0	0	0	0	0	0
3C1		2	0	0	0	0	0	0	0	0	0	0
3C1		3	0	0	0	0	0	0	0	0	0	0
3C1		4	0	0	0	0	0	0	0	0	0	0
3C1		5	0	0	0	0	0	0	0	0	0	0
Press	return	for	more,	a to	auit: 0	a						

 ${\tt Current\ Statistics,\ Total\ Statistics,\ and\ Interval\ Statistics\ are\ displayed\ for\ each\ E1\ CES\ port.\ The\ fields\ in\ these\ displays\ are\ defined\ as\ follows:}$

Field ¹	Description
Port	The E1 CES port for which statistics are shown.
ES	The number of Errored Seconds seen on the port.
SES	The number of Severely Errored Seconds seen on the port.
SEF	The number of Severely Errored Framing Seconds seen on the port.
UAS	The number of Unavailable Seconds seen on the port.
CSS	The number of Controlled Slip Seconds seen on the port.
PCV	The number of Path Coding Violations seen on the port.
LES ²	The number of Line Errored Seconds seen on the port.
BES	The number of Bursty Errored Seconds seen on the port.
DM	The number of Degraded Minutes seen on the port.
LCV	The number of Line Coding Violations seen on the port.

^{1.} Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15 minute interval. Total statistics are the accumulated values over all intervals and the current interval.

^{2.} RFC1406 contains more detailed information about DS1/E1 line status parameters.

4.9 DS1 CES Statistics

To view statistics for DS1 CES ports, enter the following at the statistics level:

myswit	ch::st	atist	ics>	cesds1								
Currer	nt Stat	istic	!s									
Port	ES	SES	SEF	UAS	CSS	PCV	LES	BES	DM	LCV		
1D1	351	0	0	0	0	0	0	0	0	0		
Total	Statis	tics										
Port	ES	SES	SEF	UAS	CSS	PCV	LES	BES	DM	LCV		
1D1	351	0	1	0	0	0	1	0	0	0		
Interv	al Sta	tisti	.CS									
Port	Interv	al	ES	SES	SEF	UAS	CSS	PCV	LES	BES	DM	LCV
1D1		1	0	0	1	0	0	0	1	0	0	0
1D1		2	0	0	0	0	0	0	0	0	0	0
1D1		3	0	0	0	0	0	0	0	0	0	0
Press	return	for	more.	ar t.o. o	mit: c	a						

Current Statistics, Total Statistics, and Interval Statistics are displayed for each DS1 CES port. The fields in this display are defined as follows:

Field ¹	Description
port	The DS1 CES port for which statistics are shown.
ES	The number of Errored Seconds seen on the port.
SES	The number of Severely Errored Seconds seen on the port.
SEF	The number of Severely Errored Framing Seconds seen on the port.
UAS	The number of Unavailable Seconds seen on the port.
CSS	The number of Controlled Slip Seconds seen on the port.
PCV	The number of Path Coding Violations seen on the port.
LES ²	The number of Line Errored Seconds seen on the port.
BES	The number of Bursty Errored Seconds seen on the port.
DM	The number of Degraded Minutes seen on the port.
LCV	The number of Line Coding Violations seen on the port.

^{1.} Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15 minute interval. Total statistics are the accumulated values over all intervals and the current interval.

 $^{^{2.}\,}$ RFC1406 contains more detailed information about DS1/E1 line status parameters.

To view general Circuit Emulation Services (CES) statistics, enter the following at the statistics level:

myswitch::statistics> ces

Port Service Reass Header Pointer Lost Buffer Buffer CellLoss
 Id Id Cells Errors Reframes Cells UnderFlows OverFlows Status
3Cl 2024 0 0 0 0 0 0 0 0 0
3C2 2025 0 0 0 0 0 0 0 0 0

Field	Description		
port	The CES port for which CES statistics are shown.		
Service Id The CES service ID of the CES connection for which statistics are shown.			
Reass Cells The number of cells that have been reassigned on the port.			
Header Errors	The number of header errors that have been seen on the port.		
Pointer Reframes	The number of errors encountered in the AAL1 pointer.		
Lost Cells	The number of cells that have been lost on the port.		
Buffer UnderFlows	The number of bytes lost due to missing cells.		
Buffer OverFlows	The number of extra bytes received which were not anticipated.		
CellLoss Status	Indicates whether the AAL1 state machine is currently in a state where cells are not being received.		

4.11 Call Record Statistics

You can display call record statistics for an individual switch board by entering cr at the statistics level as follows:

The fields in this display are defined as follows:

Field	Description
Up time/Down time	Up time is the time, in hundredths of a second, since call records have been enabled at the primary, secondary, or both sides. Down time is the time, in hundredths of a second, since call records have been disabled.
Failed primary data transfers	The number of failed data transfers to the primary data server.
Failed secondary data transfers	The number of failed data transfers to the secondary data server.
Calls rejected	The number of calls rejected due to a failure to allocate a call record.
Calls not recorded	The number of calls accepted even when there was a failure to allocate a call record.
Calls recorded	The number of calls for which a "start" call record was successfully generated.
Skipped data transfers	The number of skipped data transfers due to the preceding data transfers not being completed within the specified recording interval.
Terminating callrecords lost	The number of terminated call records lost due to a failure to allocate a data transfer buffer.

If call records have not been configured, you receive the following message:

```
myswitch::statistics> cr
Callrecords not configured.
```

4.12 Control Port Statistics

You can list the control port statistics for an individual switch fabric by entering ctlport at the statistics level as follows:

myswitch::statistics> ctlport				
Interface	Framing-Errors	CRC-Errors		
asx0	0	0		
qaa0	0	0		
qaa1	0	0		
qaa2	0	0		
qaa3	0	0		

Field	Description
Interface	The control port interface.
Framing-Errors	The number of ATM cells received with incorrect physical layer framing.
CRC-Errors	The number of ATM cells received with bad header CRCs.

4.13 Frame Relay Statistics

You can display Frame Relay statistics for the *FramePlus* network modules in an individual switch fabric. Enter ? at the fratm level to list the following submenu:

4.13.1 Frame Relay CPCS Statistics

You can list Frame Relay CPCS statistics for *FramePlus* network modules by entering cpcs at the fratm level as follows:



The CPCS statistics support an eight-hour sliding window of statistics, where each window or interval reflects a 15-minute period.

myswit	ch::stati	stics fr	atm> cpcs	5		
Curren	t Statist	ics				
SvcId	CPIErrs	LenErrs	SizeErrs	CRCErrs	Timeout	
4D1:00	0	0	0	0	0	
4D1:01	0	0	0	0	0	
4D1:02	0	0	0	0	0	
Interv	al Statis	tics				
SvcId	Interval	CPIErrs	LenErrs	SizeErrs	CRCErrs	Timeout
4D1:00	1	0	0	0	0	0
4D1:01	1	0	0	0	0	0
4D1:02	1	0	0	0	0	0
Total	Statistic	s				
SvcId	CPIErrs	LenErrs	SizeErrs	CRCErrs	Timeout	Intervals
4D1:00	0	0	0	0	0	1
4D1:01	0	0	0	0	0	1
4D1:02	0	0	0	0	0	1

Current Statistics, Interval Statistics, and Total Statistics are displayed for each service. The fields in this display are defined as follows:

Field ¹ Description		
SvcId	The ID number of the service for which the statistics are shown.	
Interval	The index of the current interval. The lower the index is, the newer the interval is.	
CPIErrs	The number of Common Part Indicator (CPI) errors detected.	
LenErrs	The number of length errors detected.	
SizeErrs	The number of user payload errors detected.	
CRCErrs	The number of Cyclic Redundancy Check (CRC) errors detected.	
Timeout	The number of timeouts detected.	

^{1.} Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15-minute interval. Total statistics are the accumulated values over all intervals and the current interval.

The statistics can also be displayed for just a particular service as follows:

The fields in this display are defined in the same manner as those in the previous example.

```
myswitch::statistics fratm> cpcs
No Fram Cpcs statistics available
```

4.13.2 Frame Relay OAM F5 Statistics

OAM F5 AIS/RDI cell-generation rates are used to support FRF.8 applications. You can list Frame Relay OAM F5 statistics for *FramePlus* network modules by entering oamf5 at the fratmlevel as follows:

myswit	ch::st	atistics	fratm>	oamf5		
SvcId	Dlci	RxAIS	TxAIS	RxRDI	TxRDI	TimeStamp
4A1:00	40	0	0	0	0	APR 21/1998
4A1:01	41	0	0	0	0	APR 21/1998
4A1:02	42	0	0	0	0	APR 21/1998

The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
Dlci	The Data Link Connection Identifier that identifies this Frame Relay connection.
RxAIS	The number of AIS OAM cells received on this service.
TxAIS	The number of AIS OAM cells transmitted on this service.
RxRDI	The number of RDI OAM cells received on this service.
TxRDI	The number of RDI OAM cells transmitted on this service.
TimeStamp	A starting timestamp that shows when statistics collections was enabled for the current statistics that are being counted.

The statistics can also be displayed for just a particular service and DLCI as follows:

```
myswitch::statistics fratm> oamf5 <serviceid> [<dlci>]
myswitch::statistics fratm> oamf5 4a1:00
SvcId Dlci RxAIS TxAIS RxRDI TxRDI TimeStamp
4A1:00 40 0 0 0 APR 21/1998
```

The fields in this display are defined in the same manner as those in the previous example.

```
myswitch::statistics fratm> oamf5
Searching for fratm services
No FR/ATM OAM statistics available
```

4.13.3 Frame Relay Service Statistics

You can list Frame Relay service statistics for *FramePlus* network modules by entering service at the fratmlevel as follows:

myswitch::	statis	tics fratr	n> servi o	ce				
SvcId	Vccs	RxFrame	${\tt TxFrame}$	${\tt RxDrpFm}$	${\tt TxDrpFm}$	${\tt TaggedFm}$	Time	Stamp
4A1:00	1	0	0	0	0	0	APR	21/1998
4A1:01	1	0	0	0	0	0	APR	21/1998
4A1:02	1	0	0	0	0	0	APR	21/1998

The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
Vccs	The number of connections using this service.
RxFrame	The total number of frames accepted over this service.
TxFrame	The total number of frames transmitted over this service.
RxDrpFm	The total number of frames that were discarded over this service because of an incorrect DLCI value, or a buffer overflow, etc.
TxDrpFm	The total number of frames intended to be transmitted over this service that were dropped.
TaggedFm	The total number of frames that were tagged for potential discard after being accepted over this service.
TimeStamp	A starting timestamp that shows when statistics collections was enabled for the current statistics that are being counted.

The statistics can also be displayed for just a particular service as follows:

The fields in this display are defined in the same manner as those in the previous example.

```
myswitch::statistics fratm> service
Searching for fratm services
No FRATM service statistics available
```

4.13.4 Frame Relay PVC Statistics

You can list Frame Relay PVC statistics for *FramePlus* network modules by entering vcc at the fratm level as follows:

myswit	ch::st	atistic	s fratm	n> vc	2					
SvcId	dlci	Rx	Tx	Rx	Tx	Tag	Tx	Tx	Tx	Tx
		frame	frame	drop	drop	frame	CLP0	CLP1	drp0	drp1
4A1:00	40	0	0	0	0	0	0	0	0	0
4A1:01	41	0	0	0	0	0	0	0	0	0
4A1:02	42	0	0	0	0	0	0	0	0	0

The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
dlci	The Data Link Connection Identifier that identifies this Frame Relay PVC.
Rx frame	The total number of frames accepted over this PVC.
Tx Frame	The total number of frames transmitted over this PVC.
Rx drop	The total number out of the accepted frames that were discarded over this PVC because of an incorrect DLCI value, or a buffer overflow, etc.
Tx drop	The total number of frames intended to be transmitted over this PVC that were dropped. This counter generally increments when egress rate enforcement is enabled and traffic is being sent at a higher rate from the ATM side.
Tag frame	The total number of frames tagged for potential discard by this switch on this PVC.
Tx CLP0	The total number of CLP=0 cells that were transmitted over this PVC. This counter only applies to the ATM to Frame Relay part of the PVC.
Tx CLP1	The total number of CLP=1 cells that were transmitted over this PVC. This counter only applies to the ATM to Frame Relay part of the PVC.
Tx drp0	The total number of CLP=0 cells that were dropped on a specific PVC. This counter only applies to the ATM to Frame Relay part of the PVC.
Tx drp1	The total number of CLP=1 cells that were dropped on a specific PVC. This counter only applies to the ATM to Frame Relay part of the PVC.

```
myswitch::statistics fratm> vcc
Searching for fratm services
No FRATM VCC statistics available
```

You can display FUNI statistics for the *FramePlus* network modules in an individual switch fabric. Enter ? at the funi level to list the available commands:

4.14.1 FUNI CPCS Statistics

You can list FUNI CPCS statistics for *FramePlus* network modules by entering cpcs at the funi level as follows:



The CPCS statistics support an eight-hour sliding window of statistics, where each window or interval reflects a 15-minute period.

myswitch::statistics funi> cpcs				
Current Statistics				
SvcId CPIErrs LenErrs SizeEr	rs CRCErrs Timeout			
4A1:02 0 0	0 0 0			
4A1:00 0 0	0 0 0			
4A1:01 0 0	0 0 0			
Interval Statistics				
SvcId Interval CPIErrs LenEr	rs SizeErrs CRCErrs Timeout			
4A1:02 1 0	0 0 0			
4A1:00 1 0	0 0 0			
4A1:01 1 0	0 0 0			
Total Statistics				
SvcId CPIErrs LenErrs SizeEr	rs CRCErrs Timeout Intervals			
4A1:02 0 0	0 0 1			
4A1:00 0 0	0 0 1			
4A1:01 0 0) 0 0 1			

Current Statistics, Interval Statistics, and Total Statistics are displayed for each service. The fields in this display are defined as follows:

Field ¹	Description
SvcId	The ID number of the service for which the statistics are shown.
Interval The index of the current interval. The lower the index is, the newer the interval is.	
CPIErrs	The number of Common Part Indicator (CPI) errors detected.
LenErrs	The number of length errors detected.
SizeErrs	The number of user payload errors detected.
CRCErrs	The number of Cyclic Redundancy Check (CRC) errors detected.
Timeout	The number of timeouts detected.

^{1.} Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15-minute interval. Total statistics are the accumulated values over all intervals and the current interval.

The statistics can also be displayed for just a particular service as follows:

```
myswitch::statistics funi> cpcs [<serviceid>]
myswitch::statistics funi> cpcs 4a1:02
Current Statistics
SvcId CPIErrs LenErrs SizeErrs CRCErrs Timeout
4A1:02
             0
                     0
         0
Interval Statistics
SvcId Interval CPIErrs LenErrs SizeErrs CRCErrs Timeout
       1 0 0 0 0
4A1:02
Total Statistics
SvcId CPIErrs LenErrs SizeErrs CRCErrs Timeout Intervals
4A1:02 0 0 0 0 0
                                             1
```

The fields in this display are defined in the same manner as those in the previous example.

```
myswitch::statistics funi> cpcs
No Fram Cpcs statistics available
```

4.14.2 FUNI Service Statistics

You can list FUNI service statistics for *FramePlus* network modules by entering service at the funi level as follows:

myswitch::s	statis	stics fur	ni> serv:	ice		
SvcId	Vccs	RxFrame	TxFrame	${\tt RxDrpFm}$	${\tt TxDrpFm}$	TimeStamp
4A1:02	1	0	0	0	0	APR 29/1998
4A1:00	1	0	0	0	0	APR 29/1998
4A1:01	1	0	0	0	0	APR 29/1998

The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
Vccs	The number of active connections using this service.
RxFrame	The total number of frames accepted over this service.
TxFrame	The total number of frames transmitted over this service.
RxDrpFm	The total number of frames that were discarded over this service because of an incorrect buffer overflow, etc.
TxDrpFm	The total number of frames that were tagged for potential discard after being accepted over this service.
TimeStamp	A starting timestamp that shows when statistics collections was enabled for the current statistics that are being counted.

The statistics can also be displayed for just a particular service as follows:

The fields in this display are defined in the same manner as those in the previous example.

```
myswitch::statistics funi> service
Searching for funi services
No FUNI service statistics available
```

4.14.3 FUNI PVC Statistics

You can list FUNI PVC statistics for *FramePlus* network modules by entering vcc at the funi level as follows:

myswit	ch::st	tatist	ics fun	i> vcc						
SvcId	Funi	Funi	Rx	Tx	Rx	Tx	Tx	Tx	Tx	Tx
	vpi	vci	frame	frame	drop	drop	CLP0	CLP1	drp0	drp1
4A1:02	0	42	0	0	0	0	0	0	0	0
4A1:00	0	40	0	0	0	0	0	0	0	0
4A1:01	0	41	0	0	0	0	0	0	0	0

The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
Funi vpi	The output Virtual Path Identifier (VPI) of the FUNI PVC.
Funi vci	The output Virtual Channel Identifier (VCI) of the FUNI PVC.
Rx frame	The total number of frames accepted over this PVC.
Tx frame	The total number of frames transmitted over this PVC.
Rx drop	The total number out of the accepted frames that were discarded over this PVC because of a buffer overflow, etc.
Tx drop	The total number of frames intended to be transmitted over this PVC that were dropped. This counter generally increments when egress rate enforcement is enabled and traffic is being sent at a higher rate from the ATM side.
Tx CLP0	The total number of CLP=0 cells that were transmitted over this PVC. This counter only applies to the ATM to FUNI part of the PVC.
Tx CLP1	The total number of CLP=1 cells that were transmitted over this PVC. This counter only applies to the ATM to FUNI part of the PVC.
Tx drp0	The total number of CLP=0 cells that were dropped on a specific PVC. This counter only applies to the ATM to FUNI part of the PVC.
Tx drp1	The total number of CLP=1 cells that were dropped on a specific PVC. This counter only applies to the ATM to FUNI part of the PVC.

```
myswitch::statistics funi> vcc
Searching for funi services
No FUNI VCC statistics available
```

AMI Statistics

4.15 ICMP Statistics

You can list ICMP statistics for an individual switch fabric by entering icmp at the statistics level as follows:

myswitch::statistics> icmp		
icmp Counter	Value	Delta
icmpInMsgs	815	2
icmpInErrors	0	0
icmpInDestUnreachs	13	0
icmpInTimeExcds	0	0
icmpInParmProbs	0	0
icmpInSrcQuenchs	0	0
icmpInRedirects	0	0
icmpInEchos	802	2
icmpInEchoReps	0	0
icmpInTimestamps	0	0
icmpInTimestampReps	0	0
icmpInAddrMasks	0	0
icmpInAddrMaskReps	0	0
icmpOutMsgs	802	2
icmpOutErrors	0	0
icmpOutDestUnreachs	0	0
icmpOutTimeExcds	0	0
icmpOutParmProbs	0	0
icmpOutSrcQuenchs	0	0
icmpOutRedirects	0	0
icmpOutEchos	0	0
icmpOutEchoReps	802	2
icmpOutTimestamps	0	0
icmpOutTimestampReps	0	0
icmpOutAddrMasks	0	0
icmpOutAddrMaskReps	0	0

Field	Description
icmpInMsgs	The total number of ICMP messages which the entity received. This counter includes all those counted by icmpInErrors.
icmpInErrors	The number of ICMP messages which the entity received but determined as having ICMP-specific errors (bad ICMP checksums, bad length, etc.).
icmplnDestUnreachs	The number of ICMP Destination Unreachable messages received.

Field	Description
icmpInTimeExcds	The number of ICMP Time Exceeded messages received.
icmpInParmProbs	The number of ICMP Parameter Problem message received.
icmpInSrcQuenchs	The number of ICMP Source Quench messages received.
icmpInRedirects	The number of ICMP Redirect messages received.
icmpInEchos	The number of ICMP Echo (request) messages received.
icmpInEchoReps	The number of ICMP Echo Reply messages received.
icmpInTimestamps	The number of ICMP Timestamp (request) messages received.
icmpInTimestampReps	The number of ICMP Timestamp Reply messages received.
icmpInAddrMasks	The number of ICMP Address Mask Request messages received.
icmpInAddrMaskReps	The number of ICMP Address Mask Reply messages received.
icmpOutMsgs	The total number of ICMP messages which this entity attempted to send. This counter includes all those counted by icmpOutErrors.
icmpOutErrors	The number of ICMP messages which this entity did not send due to problems discovered within ICMP such as a lack of buffers. This value should not include errors discovered outside the ICMP layer such as the inability of IP to route the resultant datagram. In some implementations there may be no types of error which contribute to this counter's value.
icmpOutDestUnreachs	The number of ICMP Destination Unreachable messages sent.
icmpOutTimeExcds	The number of ICMP Time Exceeded messages sent.
icmpOutParmProbs	The number of ICMP Parameter Problem messages sent.
icmpOutSrcQuenchs	The number of ICMP Source Quench messages sent.
icmpOutRedirects	The number of ICMP Redirect messages sent. For a host, this object is always zero, since hosts do not send redirects.
icmpOutEchos	The number of ICMP Echo (request) messages sent.
icmpOutEchoReps	The number of ICMP Echo Reply messages sent.
icmpOutTimestamps	The number of ICMP Timestamp (request) messages sent.
icmpOutTimestampReps	The number of ICMP Timestamp Reply messages sent.
icmpOutAddrMasks	The number of ICMP Address Mask Request messages sent.
icmpOutAddrMaskReps	The number of ICMP Address Mask Reply messages sent.



The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.16 Interface Statistics

You can list interface statistics for an individual switch fabric by entering interface at the statistics level as follows:

myswitch::statistics> interface		
Interface lo0 Counter	Value	Delta
ifInOctets	1211364	20944
ifInUcastPkts	3933	68
ifInNUcastPkts	0	0
ifInDiscards	0	0
ifInErrors	0	0
ifInUnknownProtos	0	0
ifOutOctets	1211364	20944
ifOutUcastPkts	3933	68
ifOutNUcastPkts	0	0
ifOutDiscards	0	0
ifOutErrors	0	0
ifOutQLen	0	0

Press return for more, q to quit: q

Field	Description
ifInOctets	The total number of octets received on the interface, including framing characters.
ifInUcastPkts	The number of subnetwork-unicast packets delivered to a higher-layer protocol.
ifInNUcastPkts	The number of non-unicast (i.e., subnetwork-broadcast or subnetwork-multicast) packets delivered to a higher-layer protocol.
ifInDiscards	The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
ifInErrors	The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
ifInUnknownProtos	The number of packets received via the interface which were discarded because of an unknown or unsupported protocol.
ifOutOctets	The total number of octets transmitted out of the interface, including framing characters.
ifOutUcastPkts	The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.

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Field	Description
ifOutNUcastPkts	The total number of packets that higher-level protocols requested be transmitted to a non-unicast (i.e., a subnetwork-broadcast or subnetwork-multicast) address, including those that were discarded or not sent.
ifOutDiscards	The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
ifOutErrors	The number of outbound packets that could not be transmitted because of errors.
ifOutQLen	The length of the output packet queue (in packets).



The value column displays the current value of the counter. The delta column displays the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.17 IP Statistics

You can display IP statistics for an individual switch fabric by entering ip at the statistics level as follows:

myswitch::statistics> ip							
ip Counter	Value	Delta					
ipInReceives	74056	11					
ipInHdrErrors	0	0					
ipInAddrErrors	0	0					
ipForwDatagrams	0	0					
ipInUnknownProtos	0	0					
ipInDiscards	0	0					
ipInDelivers	74056	11					
ipOutRequests	0	0					
ipOutDiscards	0	0					
ipOutNoRoutes	0	0					
ipReasmReqds	0	0					
ipReasmOKs	0	0					
ipReasmFails	0	0					
ipFragOKs	0	0					
ipFragFails	0	0					
ipFragCreates	0	0					

Field	Description
ipInReceives	The total number of input datagrams received from interfaces, including those received in error.
ipInHdrErrors	The number of input datagrams discarded due to errors in their IP headers, including bad checksums, version number mismatch, other format errors, time-to-live exceeded, errors discovered in processing their IP options, etc.
ipInAddrErrors	The number of input datagrams discarded because the IP address in their IP header's destination field was not a valid address to be received at this entity. This count includes invalid addresses (e.g., 0.0.0.0) and addresses of unsupported Classes (e.g., Class E). For entities which are not IP Gateways and, therefore, do not forward datagrams, this counter includes datagrams discarded because the destination address was not a local address.

Field	Description
ipForwDatagrams	The number of input datagrams for which this entity was not their final IP destination, as a result of which an attempt was made to find a route to forward them to that final destination. In entities which do not act as IP Gateways, this counter includes only those packets which were Source-Routed via this entity, and the Source-Route option processing was successful.
ipInUnknownProtos	The number of locally-addressed datagrams received successfully but discarded because of an unknown or unsupported protocol.
ipInDiscards	The number of input IP datagrams for which no problems were encountered to prevent their continued processing, but which were discarded (e.g., for lack of buffer space). This counter does not include any datagrams discarded while awaiting re-assembly.
ipInDelivers	The total number of input datagrams successfully delivered to IP user-protocols (including ICMP).
ipOutRequests	The total number of IP datagrams which local IP user-protocols (including ICMP) supplied to IP in requests for transmission. This counter does not include datagrams counted in ipForwDatagrams.
ipOutDiscards	The number of output IP datagrams for which no problem was encountered to prevent their transmission to their destination, but which were discarded (e.g., for lack of buffer space). This counter includes datagrams counted in ipForwDatagrams if any such packets met this (discretionary) discard criterion.
ipOutNoRoutes	The number of IP datagrams discarded because no route could be found to transmit them to their destination. This counter includes any packets counted in ipForwDatagrams which meet this "no-route" criterion. This includes datagrams which a host cannot route because all of its default gateways are down.
ipReasmReqds	The maximum number of seconds which received fragments are held while they are awaiting reassembly at this entity.
ipReasmOKs	The number of IP datagrams successfully reassembled.
ipReasmFails	The number of failures detected by the IP reassembly algorithm (for whatever reason: timed out, errors, etc). This is not necessarily a count of discarded IP fragments since some algorithms (notably the algorithm in RFC-815) can lose track of the number of fragments by combining them as they are received.
ipFragOKs	The number of IP datagrams that have been successfully fragmented at this entity.
ipFragFails	The number of IP datagrams that have been discarded because they needed to be fragmented at this entity but could not be; e.g., their Don't Fragment flag was set.
ipFragCreates	The number of IP datagram fragments that have been generated as a result of fragmentation at this entity.



The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked it. The counters are reset when the switch is restarted.

4.18 IP Access Statistics

This command allows you to display the total number of IP packets that have been filtered since the switch was rebooted and to display information about the last IP packet that was dropped. Enter ipaccess at the statistics level as follows:

The fields in this display are defined as follows:

Field	Description
Total Violations	The number of IP packets dropped since the switch was last rebooted.
Last Violation	The reason for dropping the last IP packet that was dropped.
TimeOccurred	The system time at which the last IP packet was dropped.
VPI	The Virtual Path Identifier corresponding to the connection on which the last IP packet was dropped.
VCI	The Virtual Channel Identifier corresponding to the connection on which the last IP packet was dropped.
Interface	The name of the interface on which the last dropped IP packet was received.
Source	The IP address contained in the source field of the header of the last IP packet that was dropped.

If no IP packets have been filtered since the switch was last rebooted, then the following is displayed:

```
myswitch::configuration statistics> ipaccess
No violations have occurred
```

4.19 IWF Statistics

You can display physical layer statistics for all of the *FramePlus* network modules in an individual switch fabric. Enter ? at the iwf level to list the available commands:

4.19.1 DS1 Statistics

You can list the DS1 physical layer statistics for an individual *FramePlus* network module by entering ds1 at the iwf level as follows:

myswitch::statistics iwf> ds1												
Curre	nt Stat	isti	cs									
Port	ES	SES	SE	F UAS	CSS	PCV	LES	BES	DM	LCV		
4A1	382	0		0 0	0	0	0	0	0	0		
Inter	val Sta	tist	ics									
Port	Interv	ral	ES	SES	SEF	UAS	CSS	PCV	LES	BES	DM	LCV
4A1		1	901	0	0	0	0	0	0	0	0	0
4A1		2	901	0	0	0	0	0	0	0	0	0
4A1		3	901	0	0	0	0	0	0	0	0	0
4A1		4	901	0	0	0	0	0	0	0	0	0
4A1		5	901	0	0	0	0	0	0	0	0	0
4A1		6	901	0	0	0	0	0	0	0	0	0
4A1		7	901	0	0	0	0	0	0	0	0	0
4A1		8	901	0	0	0	0	0	0	0	0	0
4A1		9	901	0	0	0	0	0	0	0	0	0
4A1		10	901	0	0	0	0	0	0	0	0	0
4A1		11	901	0	0	0	0	0	0	0	0	0
4A1		12	901	0	0	0	0	0	0	0	0	0
4A1		13	901	0	0	0	0	0	0	0	0	0
4A1		14	901	0	0	0	0	0	0	0	0	0
4A1		15	901	0	0	0	0	0	0	0	0	2
Total	Statis	stics										
Port	ES	SES	SE	F UAS	CSS	PCV	LES	BES	DM	LCV		
4A1	73385	0		0 0	0	0	0	0	0	2		
Press	return	for	more	, q to	quit: (4						

Field ¹	Description
Port	The DS1 FramePlus port for which statistics are shown.
Interval	The index of the current interval. The lower the index is, the newer the interval is.
ES	The number of Errored Seconds seen on the port.
SES	The number of Severely Errored Seconds seen on the port.
SEF	The number of Severely Errored Framing Seconds seen on the port.
UAS	The number of Unavailable Seconds seen on the port.
CSS	The number of Controlled Slip Seconds seen on the port.
PCV	The number of Path Coding Violations seen on the port.
LES	The number of Line Errored Seconds seen on the port.
BES	The number of Bursty Errored Seconds seen on the port.
DM	The number of Degraded Minutes seen on the port.
LCV	The number of Line Coding Violations seen on the port.

^{1.} Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15 minute interval. Total statistics are the accumulated values over all intervals and the current interval.

4.19.2 E1 Statistics

You can list E1 physical layer statistics for an individual *FramePlus* network module by entering e1 at the iwf level as follows:

myswitch::statistics iwf> e1												
Curre	Current Statistics											
Port	ES	SES	SEF	UAS	CSS	PCV	LES	BES	DM	LCV		
4D1	602	0	0	0	0	0	0	0	0	0		
Inter	val Stat	tist	ics									
Port	Interva	al	ES	SES	SEF	UAS	CSS	PCV	LES	BES	DM	LCV
4D1		1	901	0	0	0	0	0	0	0	0	0
4D1		2	901	0	0	0	0	0	0	0	0	0
4D1		3	901	0	0	0	0	0	0	0	0	0
4D1		4	901	0	0	0	0	0	0	0	0	0
4D1		5	870	0	0	0	0	0	0	0	0	1
Total	Total Statistics											
Port	ES	SES	SEF	UAS	CSS	PCV	LES	BES	DM	LCV		
4D1	5077	0	0	0	0	0	0	0	0	1		
Press	return	for	more,	q to	quit: 0	1						

Current Statistics, Total Statistics, and Interval Statistics are displayed for each E1 *FramePlus* port. The fields in this display are defined as follows:

Field ¹	Description
Port	The E1 FramePlus port for which statistics are shown.
Interval	The index of the current interval. The lower the index is, the newer the interval is.
ES	The number of Errored Seconds seen on the port.
SES	The number of Severely Errored Seconds seen on the port.
SEF	The number of Severely Errored Framing Seconds seen on the port.
UAS	The number of Unavailable Seconds seen on the port.
CSS	The number of Controlled Slip Seconds seen on the port.
PCV	The number of Path Coding Violations seen on the port.
LES	The number of Line Errored Seconds seen on the port.
BES	The number of Bursty Errored Seconds seen on the port.
DM	The number of Degraded Minutes seen on the port.
LCV	The number of Line Coding Violations seen on the port.

^{1.} Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15 minute interval. Total statistics are the accumulated values over all intervals and the current interval.

4.20 Network Module Statistics

You can list network module statistics about the uptime of all of the network modules in an individual switch fabric by entering module at the statistics level.

```
myswitch::statistics> module
Module Uptime
1C     3d:20:46
1D     3d:20:46
```

The fields in this display are defined as follows:

Field	Description
Module	The number of each network module that is currently installed in the switch fabric. The number designates which switch fabric it is. The letter shows the position of the network module in the switch fabric.
Uptime	The length of time that this network module has been in its current state.

You can list network module output buffer statistics about all of the network modules in an individual switch fabric. The statistics on an ASX-1000 and TNX-1100 are displayed as follows:

<pre>myswitch::statistics> module [obuf traffic] [<module>]</module></pre>								
myswit	ch::statist:	ics> module	obuf					
Module	Priority	Status	Size	QLength	Overflows			
1A	UBR	disabled	4096	0	0			
1A	VBR	disabled	4096	0	0			
1A	ABR	disabled	4096	0	0			
1A	CBR	disabled	4096	0	0			

The statistics on an ASX-200BX, ASX-200WG, and TNX-210 are displayed as follows:

myswitch::statistics> module obuf									
Module	Priority	Status	Size	QLength	Overflows				
1A	ABR/UBR	disabled	0	0	0				
1A	CBR/VBR	disabled	0	0	0				
1B	ABR/UBR	enabled	512	0	0				
1B	CBR/VBR	enabled	512	0	0				
1C	ABR/UBR	disabled	0	0	0				
1C	CBR/VBR	disabled	0	0	0				
1D	ABR/UBR	disabled	0	0	0				
1D	CBR/VBR	disabled	0	0	0				

The fields in t	hese displ	avs are defi	ined as follows:
THE HEIGHT III C	nese anspi	a jo are aer	inca as rono iis.

Field	Description				
Module	The number of each network module that is currently installed in the switch fabric.				
Priority	The traffic priority for each queue. On an ASX-200BX, an ASX-200WG, and a TNX-210, there are two queues. One corresponds to ABR/UBR traffic and one corresponds to CBR/VBR traffic. On an ASX-1000 and a TNX-1100, there are four queues. One corresponds to UBR traffic, one to VBR traffic, one to ABR traffic, and one to CBR traffic.				
Status	Shows whether the buffer is enabled or disabled.				
Size	The buffer size. On an ASX-1000 and a TNX-1100, it is 4,096.				
QLength	The number of cells currently in this queue.				
Overflows	The number of overflows in this queue.				

You can list output buffer statistics about a specific network module as follows:

```
myswitch::statistics> module [<module>]
myswitch::statistics> module 1c

Module Priority Status Size QLength Overflows
1C 0 enabled 512 0 0
1C 1 enabled 512 0 0
```

The fields in this display have the same meanings as the descriptions listed above for all of the network modules.

You can also list traffic statistics about all of the network modules or about a specific network module as follows:

The following is displayed for Series C network modules:

The following is displayed for Series LC and Series LE network modules:

```
myswitch::statistics> module traffic

Module Model Ucasts Mcasts Cells Shared Used
2B 2 16 1 0 21916 1
```

The following is displayed for Series D network modules:

Field	Description
Module	The shared memory network module for which information is being displayed.
Model	The traffic memory model being used for this shared memory network module.
Ucasts	The number of unicast connections that are currently active on this shared memory network module.
Mcasts	The number of multicast connections that are currently active on this shared memory network module.
MOuts	The number of multicast outputs that are currently active on this shared memory network module. This field does not apply to Series LC or Series LE network modules.
Cells	The number of cells currently in the dedicated queues and in the shared memory for this network module.
Shared	The amount of shared memory that is configured for this network module.
Used	The amount of shared memory that is currently being used on this network module. This field does not apply to Series D network modules.

4.21 NSAP Filter Statistics

These commands let you display NSAP address filtering statistics for an individual switch fabric. Enter? at the nsapfilter level to display the available commands.

4.21.1 NSAP Filtering Statistics

You can display NSAP address filtering statistics for an individual switch fabric by entering calls at the nsapfilter level as follows:

myswi	tch:	statistics	nsapfilter>	call	3
Port VPI Direction		Accept R	eject	Unmatched	
1A1	0	incoming	0	0	0
1A1	0	outgoing	0	0	0
1A2	0	incoming	0	0	0
1A2	0	outgoing	0	0	0
1A3	0	incoming	0	0	0
1A3	0	outgoing	0	0	0
1A4	0	incoming	0	0	0
1A4	0	outgoing	0	0	0

Field	Description
Port	The port number of the interface.
VPI	The virtual path number of the interface.
Direction	Shows if this is an incoming or outgoing interface.
Accept	The total number of calls that have been accepted by the NSAP address filtering feature on this interface.
Reject	The total number of calls that have been rejected by the NSAP address filtering feature on this interface because the supplied address matched a template in the NSAP address filtering table for which the action was to reject the call.
Unmatched	The total number of calls that have been rejected by the NSAP address filtering feature on this interface because the supplied address did not match any templates in the NSAP address filtering table.

You can also display NSAP filter statistics for just an individual port or port and path as follows:

The fields in this display are defined in the same manner as those in the previous example.

4.21.2 NSAP Filter Last Failure Statistics

You can display statistics about the last failed call attempt for an individual switch fabric by entering lastfailure at the nsapfilter level as follows:

Field	Description				
Direction	Shows whether the incoming or the outgoing filter rejected the last call attempt. 0 means no calls have been rejected since the switch was last rebooted.				
Template	The index number of the template that rejected the last call attempt. If the call was rejected because its addresses were not known, then a 0 is displayed.				
Name	The name of the template that rejected the last call attempt. If there is no name assigned to the template, then Unknown is displayed.				
Source Port	The incoming port number of the last failed call attempt.				
Source VPI	The incoming virtual path number of the last failed call attempt.				
Destination Port	The outgoing port number of the last failed call attempt.				
Destination VPI	The outgoing virtual path number of the last failed call attempt.				
Source NSAP	The source address of the last failed call attempt.				
Destination NSAP	The destination address of the last failed call attempt.				

4.22 OAM Statistics

When a physical layer fault (loss of carrier, loss of frame, etc.) is detected on a port that has AIS/RDI (Alarm Indication Signal)/(Remote Defect Indication) enabled, OAM cells are generated for all through paths, originating paths, PVCs, and PNNI SPVCs that originate on that port. If a virtual path AIS condition is indicated (by receipt of F4 AIS cells on a terminating path), OAM cells are generated for only that path and for channels (PVCs and PNNI SPVCs) that originate on that path.

An AIS is sent in the downstream direction (away from the failure). Receiving an AIS cell indicates that a physical layer failure condition is present upstream from the receiver. An RDI cell is sent toward the failure when a physical fault or AIS condition is detected on the virtual path and channel. Receiving a RDI cell indicates that a fault exists in the transit pathway of the virtual connection described by the RDI cell.



Currently, AIS/RDI OAM cell generation is supported only for point-to-point connections.

You can display OAM statistics about all of the network modules in an individual switch fabric. Enter? at the statistics oam level to list the following submenu:

```
myswitch::statistics oam> ?
f4    f5
```

4.22.1 F4 Statistics

The F4 cell is an OAM cell that reports alarm conditions which are relevant to virtual paths. You can display F4 statistics by entering £4 at the statistics oam level as follows:

myswit	myswitch::statistics oam> f4								
Input		Output		TxAIS	RxAIS	TxRDI	RxRDI		
Port	VPI	Port	VPI	Cells	Cells	Cells	Cells		
1B2	0	orig/	term	N/A	0	5	0		
1B4	0	orig/	term	N/A	5	2	0		
1B6	0	orig/	term	N/A	0	0	6		
1B2	10	1A2	10	8	N/A	N/A	N/A		

The fields in this display are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number for this port.
Output Port	The outgoing port number if it is a through path. Shows orig/term if it is an originating or terminating path (virtual path terminator).
Output VPI	The outgoing virtual path number for this port if it is a through path. Shows orig/term if it is an originating or terminating path (virtual path terminator).
TxAIS Cells	The number of AIS OAM cells sent on this path and port.
RxAIS Cells	The number of AIS OAM cells received on this path and port.
TxRDI Cells	The number of AIS OAM cells sent on this path and port.
RxRDI Cells	The number of RDI OAM cells received on this path and port.

This command is valid only if AIS/RDI OAM cell generation has been enabled. If it is not enabled on any ports, then the following is displayed:

No OAM path information available

You can also display F4 statistics for a specific port or for a specific port and path as follows:

	myswitch::statistics oam> f4 [<port> [<vpi>]]</vpi></port>								
myswitch::statistics oam>				f4 1B4	. 0				
	Input		Outpu	t	TxAIS		RxAIS	TxRDI	RxRDI
	Port	VPI	Port	VPI	Cells		Cells	Cells	Cells
	1B4	0	orig/	term	N/A		5	2	0

The fields in this display are defined in the same manner as those in the previous example.

4.22.2 F5 Statistics

The F5 cell is an OAM cell that reports alarm conditions which are relevant to virtual channels. You can display F5 statistics by entering £5 at the statistics oam level as follows:

myswit	ch::s	tatis	tics o	am> f	5	
Input			Outpu	.t		TxAIS
Port	VPI	VCI	Port	VPI	VCI	Cells
1B2	0	100	1A1	0	100	17
1B2	0	110	1A2	0	110	2

The fields in this display have the following meanings:

Field	Description		
Input Port	The incoming port number.		
Input VPI	The incoming virtual path number for this port.		
Input VCI	The incoming virtual channel number for this port.		
Output Port	The outgoing port number.		
Output VPI	The outgoing virtual path number for this port.		
Output VCI	The outgoing virtual channel number for this port.		
TxAIS Cells	The number of AIS OAM cells sent on this path, port, and channel.		

This command is valid only if AIS/RDI OAM cell generation has been enabled. If it is not enabled on any ports, then the following is displayed:

```
No OAM channel information available
```

You can also display F5 statistics for a specific port or for a specific port and path as follows:

The fields in this display are defined in the same manner as those in the previous example.

4.23 Port Statistics

You can display port statistics about all of the ports on an individual switch fabric by entering port at the statistics level as follows:

myswi	itch:	:stat	istics>	> por	t					
	Inpu	.t		Outp	ut		Cells	Cells		
Port	VPs	VCs	BW	VPs	VCs	BW	Received	Transmitted	ErrSecs	Overflows
1A1	1	7	0.8K	1	7	3.4M	20452	20670	0	0
1A2	1	6	0.8K	1	6	0.8K	0	19662	0	0
1A3	1	6	0.8K	1	6	0.8K	0	19662	0	0
1A4	1	6	0.8K	1	6	0.8K	0	19662	0	0
1CTL	2	31	0.0K	1	38	0.0K	256444	0	0	0

The fields in this display are defined as follows:

Field	Description
Port	The port number.
Input VPs	The total number of incoming VPCs and VPTs that exist on this port.
Input VCs	The total number of incoming virtual channels that exist on this port.
Input BW	The amount of bandwidth currently being used by all of the incoming VPCs and VPTs on this port.
Output VPs	The total number of outgoing VPCs and VPTs that exist on this port.
Output VCs	The total number of outgoing virtual channels that exist on this port.
Output BW	The amount of bandwidth currently being used by all of the outgoing VPCs and VPTs on this port.
Cells Received	The number of cells received on this port.
Cells Transmitted	The number of cells transmitted on this port.
ErrSecs	The number of seconds in which errored cells were dropped by this port.
Overflows	The number of cells dropped on this port because the output buffer was full.

You can also display statistics about a particular kind of network module or a specific port on a network module. Additionally, you can display port traffic statistics for a specified port. Enter the following parameters to display your choices:

```
myswitch::> stat port [(ds1 | ds3 | e1 | e3 | j2 | sonet | tp25 | fabric | traffic)]
[<port>]
```

See the following subsections for more information about each of these options.

4.23.1 DS1 Port Statistics

You can display statistics about all of the DS1 network modules in an individual switch fabric by entering ds1 at the statistics port level. This command is available only when at least one DS1 network module is installed in the switch fabric.

myswitch::statistics> port ds1				
dsl Port 1A1 Counter	Value	Delta		
dslFramingLOSs	109356	0		
ds1FramingLCVs	0	0		
dslFramingFERRs	0	0		
ds1Framing00Fs	0	0		
dslFramingAISs	0	0		
ds1FramingYellowAlarms	0	0		
ds1FramingRedAlarms	0	0		
dslFramingBEEs	0	0		
ds1FramingPRBSs	0	0		
ds1FramingBERs	0	0		
ds1PlcpBIP8s	0	0		
ds1PlcpFERRs	0	0		
ds1PlcpFEBEs	0	0		
ds1PlcpLOFs	0	0		
ds1PlcpYellows	0	0		
ds1AtmHCSs	0	0		
ds1AtmRxCells	0	0		
dslAtmTxCells	377119	0		
dslAtmUHCSs	0	0		
dslAtmCHCSs	0	0		
ds1AtmLCDs	0	0		



The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted or when a network module is replaced.



The PLCP counters increment only when the DS1 network module is running in the PLCP mode, but the HCS counter always increments, regardless of which mode is running. The PLCP counters do not apply to Series D DS1 network modules.

Field	Description
ds1FramingLOSs	The number of seconds in which Loss Of Signal (LOS) errors have been detected.
ds1FramingLCVs	The number of Line Code Violations (LCV) that have been detected.
ds1FramingFERRs	The number of DS1 framing error (FERR) events that have been detected.
ds1FramingOOFs	The number of DS1 Out Of Frame (OOF) error events that have been detected.
ds1FramingAISs	The number of seconds in which Alarm Indication Signals (AIS) were detected by the DS1 Receive Framer block. AIS means an upstream failure has been detected by the far end.
ds1FramingYellowAlarms	The number of seconds in which Yellow Alarm events have been detected.
ds1FramingRedAlarms	The number of seconds in which Red Alarm events have been detected.
ds1FramingBEEs	The number of Bit Encoding Error (BEE) events that have been detected.
ds1FramingPRBSs	The number of seconds in which Pseudo Random Bit Sequence (PRBS) patterns have been detected.
ds1FramingBERs	The number of PRBS Bit Error events that have been detected.
ds1PlcpBIP8s	The number of BIP-8 (Bit Interleaved Parity-8) error events. The BIP-8 is calculated over the Path Overhead field and the associated ATM cell of the previous PLCP frame. A BIP-N is a method of error monitoring. An N-bit code is generated by the transmitting equipment in such a manner that the first bit of the code provides even parity over the first bit of all N-bit sequences in the previous VT SPE, the second bit provides even parity over the second bits of all N-bit sequences within the specified portion, etc.
ds1PlcpFERRs	The number of Physical Layer Convergence Protocol (PLCP) octet error events.
ds1PlcpFEBEs	The number of ATM Far End Block Error (FEBE) events.
ds1PlcpLOFs	The number of seconds in which Loss Of Frame (LOF) errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. LOF is declared when an Out Of Frame state persists for more than 1ms. LOF is removed when an in-frame state persists for more than 12ms.
ds1PlcpYellows	The number of seconds in which Yellow alarm errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. Yellow alarm is asserted when 10 consecutive yellow signal bits are set to logical 1. Yellow signals are used to alert upstream terminals of a downstream failure in order to initiate trunk conditioning on the failure circuit.
ds1AtmHCSs	The number of header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.

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Field	Description
ds1AtmRxCells	The number of ATM cells that were received, not including idle/unassigned cells.
ds1AtmTxCells	The number of ATM cells that were sent, not including idle/unassigned cells.
ds1AtmUHCSs	The number of uncorrectable header check sequence (UHCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
ds1AtmCHCSs	The number of correctable header check sequence (CHCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
ds1AtmLCDs	The number of seconds in which Loss of Cell Delineation (LCD) has occurred. An LCD defect is detected when an out of cell delineation state has persisted for 4ms. An LCD defect is cleared when the sync state has been maintained for 4ms.

4.23.2 DS3 Port Statistics

You can list statistics about all of the DS3 network modules in an individual switch fabric by entering ds3 at the statistics port level. This command is available only when at least one DS3 network module is installed in the switch fabric.

myswitch::statistics> port ds3		
ds3 Port 1C1 Counter	Value	Delta
ds3FramingLOSs	0	0
ds3FramingLCVs	1504	0
ds3FramingSumLCVs	633	0
ds3FramingFERRs	1218	0
ds3FramingOOFs	1	0
ds3FramingFERFs	0	0
ds3FramingAISs	0	0
ds3FramingPbitPERRs	106	0
ds3FramingCbitPERRs	102	0
ds3FramingFEBEs	43035	0
ds3FramingIDLEs	0	0
ds3PlcpFERRs	3503	0
ds3PlcpLOFs	4	0
ds3PlcpBIP8s	1379	0
ds3PlcpFEBEs	128338	0
ds3PlcpYellows	0	0
ds3AtmHCSs	1153	0
ds3AtmRxCells	704	0
ds3AtmTxCells	8959	0



All of the PLCP counters listed above increment only when the DS3 network module is running in the PLCP mode. However, the HCS counter always increments, regardless of which mode is running.

Field	Description
ds3FramingLOSs	The number of seconds in which Loss Of Signal (LOS) errors were detected by the DS3 Receive Framer block.
ds3FramingLCVs	The number of Line Code Violations (LCV) detected by the DS3 Receive Framer block.
ds3FramingSumLCVs	The number of DS3 information blocks (85 bits) which contain one or more Line Code Violations (LCV).

Field	Description	
ds3FramingFERRs	The number of DS3 framing error (FERR) events.	
ds3FramingOOFs	The number of seconds in which DS3 Out Of Frame (OOF) error events occurred.	
ds3FramingFERFs	The number of seconds in which a Far End Receive Failure (FERF) state has been detected by the DS3 Receive Framer block. The FERF signal alerts the upstream terminal that a failure has been detected along the downstream line.	
ds3FramingAISs	The number of seconds in which Alarm Indication Signals (AIS) were detected by the DS3 Receive Framer block. AIS means an upstream failure has been detected by the far end.	
ds3FramingPbitPERRs	The number of P-bit parity error (PERR) events.	
ds3FramingCbitPERRs	The number of C-bit parity error (PERR) events.	
ds3FramingFEBEs	The number of DS3 far end block error (FEBE) events.	
ds3FramingIDLEs	The number of seconds in which an IDLE signal was detected by the DS3 Receive Framer block.	
ds3PlcpFERRs	The number of Physical Layer Convergence Protocol (PLCP) octet error events.	
ds3PlcpLOFs	The number of seconds in which Loss Of Frame (LOF) errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. LOF is declared when an Out-Of-Frame state persists for more than 1ms. LOF is removed when an in-frame state persists for more than 12ms.	
ds3PlcpBIP8s	The number of BIP-8 (Bit Interleaved Parity-8) error events. The BIP-8 is calculated over the Path Overhead field and the associated ATM cell of the previous PLCP frame. A BIP-N is a method of error monitoring. An N-bit code is generated by the transmitting equipment in such a manner that the first bit of the code provides even parity over the first bit of all N-bit sequences in the previous VT SPE, the second bit provides even parity over the second bits of all N-bit sequences within the specified portion, etc.	
ds3PlcpFEBEs	The number of ATM Far End Block Error (FEBE) events.	
ds3PlcpYellows	The number of seconds in which Yellow alarm errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. The yellow alarm is asserted when 10 consecutive yellow signal bits are set to logical 1. Yellow signals are used to alert upstream terminals of a downstream failure in order to initiate trunk conditioning on the failure circuit.	
ds3AtmHCSs	The number of the header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.	
ds3AtmRxCells	The number of ATM cells that were received, not including idle/unassigned cells.	
ds3AtmTxCells	The number of ATM cells that were sent, not including idle/unassigned cells.	



The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted or when a network module is replaced.

4.23.3 E1 Port Statistics

You can display statistics about all of the E1 network modules in an individual switch fabric by entering e1 at the statistics port level. This command is available only when at least one E1 network module is installed in the switch fabric.

myswitch::statistics> port e1		
el Port 1D1 Counter	Value	Delta
elFramingLCVs	0	0
elFramingFERRs	0	0
elFramingFEBEs	0	0
elFramingCRCs	0	0
elFraming00Fs	1	0
elFramingLOSs	0	0
elFramingAISs	0	0
elFramingAISDs	0	0
elFramingRedAlarms	0	0
elFramingYellowAlarms	0	0
elPlcpBIP8s	0	0
elPlcpFERRs	0	0
elPlcpFEBEs	0	0
elPlcpLOFs	844	17
elPlcpYellows	0	0
e1AtmHCSs	0	0
elAtmRxCells	19007	264
elAtmTxCells	19352	264
e1AtmUHCSs	0	0
e1AtmCHCSs	0	0
elAtmLCHDs	0	0
Press return for more, q to qui	t: q	



The PLCP counters increment only when the E1 network module is running in the PLCP mode, but the HCS counter always increments, regardless of which mode is running. The PLCP counters do not apply to Series D E1 network modules at all.

Field	Description	
e1FramingLCVs	The number of Line Code Violations (LCV) detected by the E1 Receive Framer block.	
e1FramingFERRs	The number of E1 framing error (FERR) events.	
e1FramingFEBEs	The number of E1 far end block errors.	
e1FramingCRCs	The number of cyclic redundancy check errors.	
e1FramingOOFs	The number of OOF (loss of basic frame alignment) errors that have been detected.	
e1FramingLOSs	The number of seconds in which LOS (loss of signal) error events occurred.	
e1FramingAISs	The number of seconds in which AIS (alarm indication signal) error events occurred.	
e1FramingAISDs	The number of seconds in which AISD (unframed pattern of all ones) error events occurred.	
e1FramingRedAlarms	The number of seconds in which Red Alarm events were experienced.	
e1FramingYellowAlarms	The number of seconds in which Yellow Alarm events were experienced.	
e1PlcpBIP8s	The number of BIP-8 (Bit Interleaved Parity-8) error events. The BIP-8 is calculated over the Path Overhead field and the associated ATM cell of the previous PLCP frame. A BIP-N is a method of error monitoring. An N-bit code is generated by the transmitting equipment in such a manner that the first bit of the code provides even parity over the first bit of all N-bit sequences in the previous VT SPE, the second bit provides even parity over the second bits of all N-bit sequences within the specified portion, etc.	
e1PlcpFERRs	The number of Physical Layer Convergence Protocol (PLCP) octet error events.	
e1PlcpFEBEs	The number of ATM Far End Block Error (FEBE) events.	
e1PlcpLOFs	The number of seconds in which Loss Of Frame (LOF) errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. OOF is declared when an error is detected in both the A1 and A2 octets or when 2 consecutive POHID octets are found in error. LOF is declared when an OOF state persists for more than 20ms. LOF is removed upon finding two valid consecutive sets of framing (A1 and A2) octets and two valid sequential path overhead identifier octets.	
e1PlcpYellows	The number of seconds in which Yellow alarm errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. Yellow alarm is asserted when 10 consecutive yellow signal bits are set to logical 1. Yellow signals are used to alert upstream terminals of a downstream failure in order to initiate trunk conditioning on the failure circuit.	
e1AtmHCSs	The number of header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.	
e1AtmRxCells	The number of ATM cells that were received, not including idle/unassigned cells.	
e1AtmTxCells	The number of ATM cells that were sent, not including idle/unassigned cells.	
e1AtmUHCSs	The number of uncorrectable header check sequence (UHCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.	



The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted or when a network module is replaced.

4.23.4 E3 Port Statistics

You can display statistics about all of the E3 network modules in an individual switch fabric by entering e3 at the statistics port level. This command is available only when at least one E3 network module is installed in the switch fabric.

myswitch::statistics> port e3		
e3 Port 1D1 Counter	Value	Delta
e3FramingLOSs	85974	0
e3FramingLCVs	3684415794	0
e3FramingFERRs	85173622	0
e3FramingOOFs	85974	0
e3FramingFERFs	0	0
e3FramingAISs	0	0
e3FramingBIP8s	636877586	0
e3FramingFEBEs	2465566	0
e3PlcpFERRs	0	0
e3PlcpLOFs	171950	0
e3PlcpBIP8s	0	0
e3PlcpFEBEs	0	0
e3PlcpYellows	0	0
e3AtmHCSs	0	0
e3AtmRxCells	0	0
e3AtmTxCells	281929	0
Press return for more, a to qui	t: q	



All of the PLCP counters listed above increment only when the E3 network module is running in the PLCP mode. However, the HCS counter always increments, regardless of which mode is running.

Field	Description
e3FramingLOSs	The number of seconds in which Loss Of Signal (LOS) errors were detected by the E3 Receive Framer block.
e3FramingLCVs	The number of Line Code Violations (LCV) that were detected by the E3 Receive Framer block.
e3FramingFERRs	The number of E3 framing error (FERR) events.

Field	Description
e3FramingOOFs	The number of seconds in which E3 Out Of Frame (OOF) error events were experienced.
e3FramingFERFs	The number of seconds in which Far End Receive Failures for a port configured with HCS framing were experienced. Indicates the number of seconds in which Remote Alarm Indications for a port configured with PLCP framing were experienced.
e3FramingAISs	The number of seconds in which Alarm Indication Signals (AIS) were detected by the E3 Receive Framer block. AIS indicates that an upstream failure has been detected by the far end.
e3FramingFEBEs	The number of E3 far end block error (FEBE) events.
e3FramingBIP8s	The number of E3 G.832 BIP-8 errors. This counter is only valid for a port using HCS framing.
e3PlcpFERRs	The number of Physical Layer Convergence Protocol (PLCP) octet error events.
e3PlcpLOFs	The number of seconds in which Loss Of Frame (LOF) errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. LOF is declared when an Out-Of-Frame state persists for more than 1ms. LOF is removed when an in-frame state persists for more than 12ms.
e3PlcpBIP8s	The number of BIP-8 (Bit Interleaved Parity-8) error events. The BIP-8 is calculated over the Path Overhead field and the associated ATM cell of the previous PLCP frame. A BIP-N is a method of error monitoring. An N-bit code is generated by the transmitting equipment in such a manner that the first bit of the code provides even parity over the first bit of all N-bit sequences in the previous VT SPE, the second bit provides even parity over the second bits of all N-bit sequences within the specified portion, etc.
e3PlcpFEBEs	The number of ATM Far End Block Error (FEBE) events.
e3PlcpYellows	The number of seconds in which Yellow alarm errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. Yellow alarm is asserted when 10 consecutive yellow signal bits are set to logical 1. Yellow signals are used to alert upstream terminals of a downstream failure in order to initiate trunk conditioning on the failure circuit.
e3AtmHCSs	The number of header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
e3AtmRxCells	The number of ATM cells that were received, not including idle/unassigned cells.
e3AtmTxCells	The number of ATM cells that were sent, not including idle/unassigned cells.



The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted or when a network module is replaced.

4.23.5 J2 Port Statistics

You can display statistics about all of the J2 network modules in an individual switch fabric by entering j2 at the statistics port level. This command is available only when at least one J2 network module is installed in the switch.

myswitch::statistics> port j2		
j2 Port 1A1 Counter	Value	Delta
j2B8ZSCodingErrors	255	0
j2CRC5Errors	0	0
j2FramingErrors	0	0
j2RxLossOfFrame	0	0
j2RxLossOfClock	0	0
j2RxAIS	0	0
j2TxLossOfClock	0	0
j2RxRemoteAIS	0	0
j2AtmHCSs	0	0
j2AtmRxCells	136924	0
j2AtmTxCells	120988	0
Press return for more, q to qu	it: q	

Field	Description
j2B8ZSCodingErrors	The number of B8ZS coding violation errors.
j2CRC5Errors	The number of CRC-5 received errors.
j2FramingErrors	The number of framing patterns received in error.
j2RxLossOfFrame	The number of seconds during which the receiver was experiencing Loss Of Frame.
j2RxLossOfClock	The number of seconds during which the receiver was not observing transitions on the received clock signal.
j2RxAIS	The number of seconds during which the receiver detected an Alarm Indication Signal.
j2TxLossOfClock	The number of seconds during which the transmitter experienced Loss Of Clock.
j2RxRemoteAIS	The number of seconds during which the receiver observed the Alarm Indication Signal in the m-bits channel.
j2AtmHCSs	The number of header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
j2AtmRxCells	The number of ATM cells that were received.
j2AtmTxCells	The number of ATM cells that were transmitted.

4.23.6 SONET Port Statistics

You can display statistics about all of the SONET network modules on an individual switch fabric by entering sonet at the statistics port level. This command is available only when at least one SONET (OC-3, OC-12, or UTP) network module is installed in the fabric.

myswitch::statistics> port sonet		
sonet Port 1D1 Counter	Value	Delta
sonetSectionBIPs	1571776380	863766
sonetSectionLOSs	32745	18
sonetSectionLOFs	32745	18
sonetLineBIPs	0	0
sonetLineFEBEs	0	0
sonetLineAISs	32745	18
sonetLineRDIs	0	0
sonetPathBIPs	0	0
sonetPathFEBEs	0	0
sonetPathLOPs	0	0
sonetPathAISs	32745	18
sonetPathRDIs	32745	18
sonetPathUNEQs	0	0
sonetPathPLMs 0		0
sonetAtmCorrectableHCSs	0	0
sonetAtmUncorrectableHCSs 0		0
sonetAtmLCDs 32745		18
Press return for more, q to quit:	a .	

Field	Description
sonetSectionBIPs	The number of Section BIP-8 (Bit Interleaved Parity) errors that have been detected. The calculated BIP-8 code is compared with the BIP-8 code extracted from the B1 byte of the following frame. Differences indicate that a section level bit error has occurred.
sonetSectionLOSs	The number of seconds in which Loss Of Signal (LOS) has occurred. A LOS is declared when 20 +/- 3ms of all zeros patterns is detected. LOS is cleared when two valid framing words are detected and during the intervening time no LOS condition is detected.
sonetSectionLOFs	The number of seconds in which Loss Of Frame (LOF) has occurred. A LOF is declared when an out-of-frame (OOF) condition persists for 3ms. It is cleared when an in-frame condition persists for 3ms. While in-frame, the framing bytes (A1, A2) in each frame are compared against the expected pattern. OOF is declared when four consecutive frames containing one or more framing pattern errors have been received.

Field	Description
sonetLineBIPs	The number of Line BIP-24 (Bit Interleaved Parity) errors that have been detected. The calculated BIP-24 code is based on the line overhead and synchronous payload envelope (SPE) of the STS-3c stream. The line BIP-24 code is a bit interleaved parity calculation using even parity. The calculated code is compared with the BIP-24 code extracted from the B2 bytes of the following frame. Differences indicate that a line layer bit error has occurred.
sonetLineFEBEs	The number of line Far End Block Errors (FEBE) that have been detected.
sonetLineAISs	The number of seconds in which line Alarm Indication Signal (AIS) has occurred. A line AIS is asserted when a 111 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. It is removed when any pattern other than 111 is detected in these bits for five consecutive frames.
sonetLineRDIs	The the number of seconds in which a line Remote Defect Indication (RDI) has occurred. A line RDI is asserted when a 110 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. It is removed when any pattern other than 110 is detected in these bits for five consecutive frames.
sonetPathBIPs	The number of Path BIP-8 (Bit Interleaved Parity) errors that have been detected. A path BIP-8 error is detected by comparing the path BIP-8 byte (B3) extracted from the current frame, to the path BIP-8 computed for the previous frame.
sonetPathFEBEs	The number of path Far End Block Errors (FEBE) that have been detected. FEBEs are detected by extracting the 4-bit FEBE field from the path status byte (G1). The valid range for the 4-bit field is between 0000 and 1000, representing zero to eight errors. Other values are interpreted as zero errors.
sonetPathLOPs	The number of seconds in which path Loss Of Pointer (LOP) has occurred. A path LOP is detected when a "normal pointer value" is not found in eight consecutive frames. It is cleared when a "normal pointer value" is found for three consecutive frames.
sonetPathAISs	The number of seconds in which a path Alarm Indication Signal (AIS) has occurred. A path AIS is asserted when an all-ones pattern is detected in the pointer bytes (H1 and H2) for three consecutive frames and is cleared when a valid pointer is found for three consecutive frames. AIS means an upstream failure has been detected.
sonetPathRDIs	The number of seconds in which a path Remote Defect Indication (RDI) alarm has occurred. A path RDI is detected by extracting bit 5 of the path status byte. If bit 5 is high for 10 consecutive frames, then an RDI alarm is declared. An RDI alarm is cleared when bit 5 is low for 10 consecutive frames. RDI signals are used to alert upstream terminals of a downstream failure in order to initiate trunk conditioning on the failure circuit.
sonetPathUNEQs	The number of seconds in which a path UNEQ defect has occurred. A path UNEQ defect is detected when the STS Signal label (C2 byte) $== 0x00$.
sonetPathPLMs	The number of seconds in which a Path Label Mismatch (PLM) defect has occurred. A PLM defect is detected when the STS Signal label (C2 bytes) != 0x00, 0x01, 0x13, 0xFC, or 0xFF.
sonetAtmCorrectableHCSs	The number of correctable Header Check Sequence (HCS) error events that occurred. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.

Field	Description
sonetAtmUncorrectable- HCSs	The number of uncorrectable Header Check Sequence (HCS) error events that occurred. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
sonetAtmLCDs	The number of seconds in which a Loss of Cell Delineation (LCD) has occurred. An LCD defect is detected when an out of cell delineation state has persisted for 4ms. An LCD defect is cleared when the sync state has been maintained for 4ms.

4.23.7 TP25 Port Statistics

You can display statistics about all of the TP25 network modules in an individual switch fabric by entering tp25 at the statistics port level. The following TP25 command is available only when at least one TP25 network module is installed in the switch fabric.

myswitch::statistics> port tp25		
tp25 Port 1A1 Counter	Value	Delta
tp25ErrorSymbol	40452300	0
tp25AtmHCSs	8	0
tp25AtmRxCells	13722	0
tp25AtmTxCells	0	0
Press return for more, q to quit: q		

The fields in this display are defined as follows:

Field	Description
tp25ErrorSymbol	The number of undefined symbols received.
tp25AtmHCSs	The number of header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
tp25AtmRxCells	The number of ATM cells that were received.
tp25AtmTxCells	The number of ATM cells that were transmitted.



The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted or when a network module is replaced.

4.23.8 Fabric Port Statistics

Fabric port counters record the number of CAC (Connection Admission Control) failures, VPI allocation failures, VCI allocation failures, and connection setup errors for each port. Each port counter maintains all errors of that type that occurred on that port or on any path on that port. The counters are direction specific, meaning that errors that occurred on the input side are differentiated from errors that occurred on the output side. You can display fabric statistics about all of the ports in a switch fabric by entering fabric at the statistics port level.

myswit	.ch::> s	tat por	t fabr	ic				
	InputFailures OutputFailures							
Port	CAC	VPI	VCI	Setup	CAC	VPI	VCI	Setup
2A1	0	0	0	0	0	0	0	0
2A2	0	0	0	0	0	0	0	0
2A3	0	0	0	0	0	0	0	0
2A4	0	0	50	0	0	0	0	0
2E1	0	0	0	0	0	0	0	0
2E3	0	0	0	0	0	0	0	0
2E4	0	0	0	0	0	0	0	0
2CTL	0	0	0	0	0	0	0	0

Field	Description
Port	The port number.
Input Failures CAC	The number of input CAC failures on this port. These failures occur when there is not enough input bandwidth on the link or on an input path of that link for a connection.
Input Failures VPI	The number of input VPI allocation failures on this port that occur when an input VPI cannot be allocated because the VPI is already in use, because the VPI is out of range, or because no more VPIs are available for allocation.
Input Failures VCI	The number of input VCI allocation failures on this port that occur when an input VCI cannot be allocated on a path because the VCI is already in use, because the VCI is out of range, or because no more VCIs are available for allocation on the input path.
Input Failures Setup	The number of input connection setup failures on this port that occur if the connection cannot be set up on the fabric because the output network module cannot support the connection for various reasons, or because a connection ID cannot be allocated on an ASX-1000 or TNX-1100 fabric.
Output Failures CAC	The number of output CAC failures on this port that occur when there is not enough output bandwidth on the link or on a path of that link for a connection.
Output Failures VPI	The number of output VPI allocation failures on this port that occur when an output VPI cannot be allocated because the VPI is already in use, because the VPI is out of range, or because no more VPIs are available for allocation.

Field	Description
Output Failures VCI	The number of output VCI allocation failures on this port that occur when an output VCI cannot be allocated on a path because the VCI is already in use, because the VCI is out of range, or because no more VCIs are available for allocation on the output path.
Output Failures Setup	The number of output connection setup failures on this port that occur if the connection cannot be set up on the fabric because the output network module cannot support the connection for various reasons, or because a connection ID cannot be allocated on an ASX-1000 or TNX-1100 fabric.

You can also display fabric statistics for just a specified port in a switch fabric as follows:

myswit	ch::> s	tat por	t fabr	ic 2A4				
	Input	Failure	s		Outpu	tFailur	es	
Port	CAC	VPI	VCI	Setup	CAC	VPI	VCI	Setup
2A4	0	0	50	0	0	0	0	0

These fields are defined in the same manner as those in the previous example.

4.23.9 Traffic Port Statistics

You can display traffic statistics about all of the ports in a switch fabric by entering traffic at the statistics port level. The following is displayed for Series C network modules:

myswit	tch::statist	ics> po	ort t	raffic		
		Cells	3		Cells	Cells
Port I	Priority	Current	5	Trans	nitted	Lost
1A1 A	ABR-UBR	()		65	0
1A1 V	VBR	()		16988	0
1A1 (CBR	()		0	0
1A2 A	ABR-UBR	()		68	0
1A2 V	VBR	()		15890	0
1A2 (CBR	()		0	0
1A3 A	ABR-UBR	()		12	0
1A3 V	VBR	()		20800	0
1A3 (CBR	()		0	0
1A4 A	ABR-UBR	()		12	0
1A4 V	VBR	()		20800	0
1A4 (CBR	()		0	0
1B1 A	ABR-UBR	()		12	0
1B1 V	VBR	()	-	113401	0
1B1 (CBR	()		0	0
Press	return for	more,	q to	quit:		

You can also display traffic statistics for just a specified port. Enter the following parameters:

myswitch::statistics> port traffic 1a1					
		Cells	Cells	Cells	
Port	Priority	Current	Transmitted	Lost	
1A1	ABR-UBR	0	65	0	
1A1	VBR	0	16988	0	
1A1	CBR	0	0	0	

The following is displayed for Series LC and Series LE network modules:

mysw	itch::stati	stics> por	rt traffic			
		Cells	Cells	Cells	CellsLost	CellsLost
Port	Priority	Current	Transmitted	Lost	Intent	Unintent
2B1	ABR	0	0	0	0	0
2B1	VBR	0	559	0	0	0
2B1	CBR	0	0	0	0	0
2B1	UBR	0	115	0	0	0
2B2	ABR	0	0	0	0	0
2B2	VBR	0	527	0	0	0
2B2	CBR	0	0	0	0	0
2B2	UBR	0	109	0	0	0
2B3	ABR	0	0	0	0	0
2B3	VBR	0	528	0	0	0
2B3	CBR	0	0	0	0	0
2B3	UBR	0	109	0	0	0
Pres	s return for	r more, q	to quit: q			

Field	Description
Port	The port number.
Priority	The traffic type for this port.
Cells Current	The number of cells currently in shared memory for this port and priority.
Cells Transmitted	The number of cells transmitted out this port for this priority.
Cells Lost	The number of cells for this port and priority dropped by the output network module.
CellsLost Intent	The number of cells that were dropped for this port and priority queue due to EPD (Early Packet Discard) or PPD (Partial Packet Discard). This field applies only to Series LC and Series LE network modules.
CellsLost Unintent	The number of cells that were dropped for this port and priority queue due to output memory shortages or the CLP (Cell Loss Priority) threshold. This field applies only to Series LC and Series LE network modules.

myswitch::statistics> po	ort	traffic
--------------------------	-----	---------

Cells			CellsLost							
	Port	Class	Current	Tx	EPD	CLP0+1	CLP1	VC	Overflow	PPD
	2B1	ABR	0	0	0	0	0	0	0	0
	2B1	VBR	0	504	0	0	0	0	0	0
	2B1	CBR	0	0	0	0	0	0	0	0
	2B1	UBR	2	31.91M	0	0	0	0	0	0

Field	Description
Port	The port number.
Class	The traffic type for this port.
Cells Current	The number of cells currently in shared memory for this port and class.
Cells Tx ¹	The number of cells transmitted out this port for this class for both CLP0+1 and CLP1 cells.
CellsLost EPD	The first cell of each packet lost on this port for this class because of EPD.
CellsLost CLP0+1	The first cell of each packet lost on this port for this class because the per-port, per-class CLP=0+1 threshold was exceeded.
CellsLost CLP1	The first cell of each packet lost on this port for this class because the per-port, per-class CLP=1 threshold was exceeded.
CellsLost VC	The first cell lost on this port for this class because the per-VC CLP=1 and CLP=0+1 thresholds were exceeded.
CellsLost Overflow	The first cell of each packet lost on this port for this class because shared memory was full.
CellsLost PPD	The total number of cells (except the first cell of each packet) lost because of EPD, because the per-port, per-class CLP=0+1 threshold was exceeded, because the per-port, per-class CLP=1 threshold was exceeded, because the per-VC CLP=1 and CLP=0+1 thresholds were exceeded, or because shared memory was full.

^{1.} This number may be less than the total cells transmitted by all VCs on this port. This is because on a multicast connection with multiple outputs to the same port, each cell is counted only once at the port level for all legs of the connection.

4.24 SPANS Statistics

You can list SPANS statistics for an individual switch fabric by entering spans at the statistics level as follows:

myswitch::statistics> spans		
Port 1D1 Counter	Value	Delta
sigPathVCCs	0	0
sigPathRestarts	0	0
sigPathCallsCompletions	0	0
sigPathCallsFailures	0	0
sigPathCallsRejections	0	0
${\tt sigPathSpansTransmittedMessages}$	193416	76
sigPathSpansReceivedMessages	0	0
sigPathClsTransmittedMessages	0	0
sigPathClsReceivedMessages	0	0
Press return for more, q to quit: q		

Field	Description
sigPathVCCs	The number of VCCs on this signalling path.
sigPathRestarts	The number of times this switch has lost and regained contact with the other side of the connection.
sigPathCallsCompletions	The number of signalling requests that were successfully completed.
sigPathCallsFailures	The number of failed signalling calls.
sigPathCallsRejections	The number of rejected requests.
sig Path Spans Transmitted Messages	The number of SPANS messages that were sent.
sigPathSpansReceivedMessages	The number of SPANS messages that were received.
sigPathClsTransmittedMessages	The number of connectionless messages that were sent.
sigPathClsReceivedMessages	The number of connectionless messages that were received.

4.25 TCP Statistics

You can display TCP statistics for an individual switch fabric by entering tcp at the statistics level as follows:

myswitch::statistics> tcp					
tcp Counter	Value	Delta			
tcpActiveOpens	0	0			
tcpPassiveOpens	20	0			
tcpAttemptFails	0	0			
tcpEstabResets	1	0			
tcpCurrEstab	2	0			
tcpInSegs	4307	10			
tcpOutSegs	3290	7			
tcpRetransSegs	0	0			

The fields in this display are defined as follows:

Field	Description
tcpActiveOpens	The number of times TCP connections have made a direct transition to the SYN-SENT state from the CLOSED state.
tcpPassiveOpens	The number of times TCP connections have made a direct transition to the SYN-RCVD state from the LISTEN state.
tcpAttemptFails	The number of times TCP connections have made a direct transition to the CLOSED state from either the SYN-SENT state or the SYN-RCVD state, plus the number of times TCP connections have made a direct transition to the LISTEN state from the SYN-RCVD state.
tcpEstabResets	The number of times TCP connections have made a direct transition to the CLOSED state from either the ESTABLISHED state or the CLOSE-WAIT state.
tcpCurrEstab	The number of TCP connections for which the current state is either ESTABLISHED or CLOSE-WAIT.
tcpInSegs	The total number of segments received, including those received in error. This count includes segments received on currently established connections.
tcpOutSegs	The total number of segments sent, including those on current connections but excluding those containing only retransmitted octets.
tcpRetransSegs	The total number of segments retransmitted; i.e., the number of TCP segments transmitted containing one or more previously transmitted octets.



The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.26 UDP Statistics

You can display UDP statistics for an individual switch fabric by entering udp at the statistics level as follows:

myswitch::statistics> udp						
udp Counter	Value	Delta	Delta			
udpInDatagrams		0	0			
udpNoPorts		0	0			
udpInErrors		0	0			
udpOutDatagrams		0				

The fields in this display are defined as follows:

Field	Description
udpInDatagrams	The total number of UDP datagrams delivered to UDP users.
udpNoPorts	The total number of received UDP datagrams for which there was no application at the destination port.
udpInErrors	The number of received UDP datagrams that could not be delivered for reasons other than the lack of an application at the destination port.
udpOutDatagrams	The total number of UDP datagrams sent from this entity.



The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

You can display signalling statistics for an individual switch fabric by entering signalling at the statistics level as follows:

myswitch::statistics> signalling					
Port 4Al Counter	Value	Delta			
q2931VCCs	0	0			
q2931Restarts	0	0			
q2931CallsCompletions	0	0			
q2931CallsFailures	0	0			
q2931CallsRejections	0	0			
q2931TransmittedMessages	0	0			
q2931ReceivedMessages	0	0			
Press return for more, q to quit: q					

The fields in this display are defined as follows:

Field	Description
q2931VCCs	The number of Virtual Channel Connections (VCCs) on this signalling channel.
q2931Restarts	The number of times the switch has lost and regained contact with the remote signalling entity on this channel.
q2931CallsCompletions	The number of successfully completed calls on this signalling channel.
q2931CallsFailures	The number of call failures on this signalling channel.
q2931CallsRejections	The number of connections on this signalling channel that were rejected by the far end.
q2931TransmittedMessages	The total number of signalling messages that have been transmitted over this signalling channel.
q2931ReceivedMessages	The total number of signalling messages that have been received on this signalling channel.



The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.28 VCC Statistics

You can display virtual channel statistics for an individual switch fabric by entering vcc at the statistics level as follows:

myswitch::statistics> vcc								
Input			Outp	ut			Cells	Cells
Port '	VPI	VCI	Port	VPI	VCI	Uptime	Received	Rejected
1A1	0	5	1CTL	0	34	0d:03:22	24123	0
1A1	0	14	1CTL	0	33	0d:03:22	29056	0
1A1	0	15	1CTL	0	32	0d:03:22	67821	0
1A1	0	16	1CTL	0	53	0d:03:22	9250	0
1A2	0	5	1CTL	0	37	0d:03:22	0	0
1A2	0	14	1CTL	0	36	0d:03:22	0	0
1A2	0	15	1CTL	0	35	0d:03:22	0	0
1A2	0	16	1CTL	0	54	0d:03:22	0	0
1A3	0	5	1CTL	0	40	0d:03:22	0	0
1A3	0	14	1CTL	0	39	0d:03:22	0	0
1A3	0	15	1CTL	0	38	0d:03:22	0	0
1A3	0	16	1CTL	0	55	0d:03:22	0	0
Press	ret	urn :	for mo	ore,	q to	quit: q		

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Input VCI	The incoming virtual channel number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Output VCI	The outgoing virtual channel number.
Uptime	The length of time that this virtual channel has been in its current state.
Cells Received	The total (aggregate) number of cells that were transferred over this channel.
Cells Rejected	The total (aggregate) number of cells over this channel that were rejected (dropped) by the hardware due to a traffic policing violation. This does not include any cells that may have been tagged with CLP=1 by the policer, only cells that were discarded.

You can also display virtual channel statistics for a specific port, for a port and path, or for a port, path, and channel on an individual switch fabric. Enter the following parameters:

```
myswitch::statistics> vcc [traffic [Qlen]] [<port> [<vpi> [<vci>]]]
myswitch::statistics> vcc lal 0 15
Input Output Cells Cells
Port VPI VCI Port VPI VCI Uptime Received Rejected
lal 0 15 lCTL 0 32 0d:03:22 67821 0
```

The fields in this display are defined in the same manner as those in the previous example. You can also show vcc traffic statistics for an individual switch fabric. The fields that are displayed vary depending on the type of network module on which the connections are output. This command does not apply to Series C network modules. If the connections are output on a Series LC network module, then the display is similar to the following:

myswitch:	nyswitch::statistics> vcc traffic							
Input		Outp	ut		Cells	CellsLost	CellsLost	Cells
Port VPI	VCI	Port	VPI	VCI	Lost	Intent	Unintent	Transmitted
2E1 0	719	2C1	0	248	0	0	0	870
2E1 0	720	2C1	0	249	0	0	0	64
2E1 0	721	2C1	0	250	0	0	0	35
2E1 0	722	2C1	0	251	0	0	0	243

Press return for more, q to quit: q

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Input VCI	The incoming virtual channel number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Output VCI	The outgoing virtual channel number.
Cells Lost	The number of cells on this channel that were dropped by the output network module.
CellsLost Intent	The number of cells dropped on this channel due to EPD (Early Packet Discard) or PPD (Partial Packet Discard).
CellsLost Unintent	The number of cells dropped on this channel due to output memory shortages or the CLP (Cell Loss Priority) threshold.
Cells Transmitted	The number of cells transmitted out this channel.

If the connections are output on a Series D network module, then the display varies depending on whether or not the module packet counter is disabled.

If the module packet counter is disabled under conf module traffic d aal5pktcount (the default setting), then the following is displayed:

myswi	tcn	··st	atist.	lcs>	AGG	trailic la	ıπ					
Input	;	Out	put			CellsTx	:	Cell	lsLost			
Port	VPI	VCI	Port	VPI	VCI	CLP0	CLP1	EPD	CLP0+1	CLP1	Unintent	Intent
1CTL	0	130	1A1	0	5	2	0	0	0	0	0	0
1CTL	0	129	1A1	0	15	64	0	0	0	0	0	0
1CTL	0	131	1A1	0	16	96	0	0	0	0	0	0

If the module packet counter is enabled under conf module traffic d aal5pktcount, the CLP0 and CLP1 cells are combined into a single CLP0+1 Tx count as follows:

mysw:	itch	::sta	atist:	ics>	VCC	traffic	1a1					
Input	5	Out	put			Cells	Packets	Cel	lsLost			
Port	VPI	VCI	Port	VPI	VCI	Tx	Tx	EPD	CLP0+1	CLP1	Unintent	Intent
1CTL	0	110	1A1	0	5	18	0	0	0	0	0	0
1CTL	0	109	1A1	0	15	27568	0	0	0	0	0	0
1 СТТ.	Ο	111	1 a 1	Ο	16	18850	0	0	0	0	Ω	Ο

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Input VCI	The incoming virtual channel number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Output VCI	The outgoing virtual channel number.
Cells Tx CLP0	Counts the number of CLP=0 cells transmitted on this channel.
Cells Tx CLP1	Counts the number of CLP=1 cells transmitted on this channel.
Cells Tx	Counts the number of CLP0+1 cells transmitted on this channel.
Packets Tx	Counts the number of packets transmitted on this channel.
Cells Lost EPD	For AAL5 traffic, counts only the first cell of each packet dropped on this channel due to EPD (Early Packet Discard). For non-AAL5 traffic, this counter is not incremented.

If the connections are output on a Series D network module, then there is also an option for displaying the current per-connection queue length. Enter the following parameters:

```
myswitch::> stat vcc [traffic [Qlen]] [<port> [<vpi> [<vci>]]]
myswitch::> stat vcc traffic Qlen 1a1
Input
        Output
Port VPI VCI Port VPI VCI
                           Olen
1CTL
      0 130 1A1
                   Ω
                       5
                              O
     0 129 1A1
                   0 15
1CTL
1CTL
     0 131 1A1
                   0 16
                              0
```

Field Description					
Input Port	The incoming port number.				
Input VPI	The incoming virtual path number.				
Input VCI	The incoming virtual channel number.				
Output Port	Output Port The outgoing port number.				
Output VPI	The outgoing virtual path number.				
Output VCI	The outgoing virtual channel number.				
Qlen	The current queue length.				

4.29 VPC Statistics

You can display virtual path statistics for an individual switch fabric by entering **vpc** at the **statistics** level as follows:



This command shows statistics for through paths only. To display statistics for originating and terminating paths, use the stat vpt command.

mysw:	itch::	statis	tics>	vpc		
Input	t	Outpu	.t		Cells	Cells
Port	VPI	Port	VPI	Uptime	Received	Rejected
1C1	100	1E4	100	4d:21:22	0	0
1C2	115	1E4	115	4d:16:35	0	0
1E4	100	1C1	100	4d:21:22	0	0
1E4	115	1C2	115	4d:16:35	0	0

The fields in this display are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Uptime	The length of time that this virtual path has been in its current state.
Cells Received	The total (aggregate) number of cells that were transferred over this path.
Cells Rejected	The total (aggregate) number of cells over this path that were rejected (dropped) by the hardware due to a traffic policing violation. This does not include any cells that may have been tagged with CLP=1 by the policer, only cells that were discarded.

If no vpcs have been configured, the following message is displayed:

```
myswitch::statistics> vpc
No virtual path connection input statistics are available
```

You can also display virtual path statistics for a specific port, or for a port and path on an individual switch fabric. Enter the following parameters:

myswitch::statistics>					<pre>vpc [traffic</pre>	[Qlen]] [<port></port>	[< <i>vpi</i> >]]
	myswi	tch::	statis	tics>	vpc 1c1 100		
	Input		Outpu	t		Cells	Cells
	Port	VPI	Port	VPI	Uptime	Received	Rejected
	1C1	100	1E4	100	4d:21:22	0	0
	1E4	100	1C1	100	4d:21:22	0	0

The fields in this display are defined in the same manner as those in the previous example.

You can also display virtual path traffic statistics for an individual switch fabric. The fields that are displayed vary depending on the type of network module on which the connections are output. This command does not apply to Series C network modules. If the connections are output on Series LC network modules, then the display is similar to the following:

		!	pc traffic	> vpc	stics>	statis	tch::	myswi
Cells	CellsLost	CellsLost	Cells		ıt	Outpu		Input
Transmitted	Unintent	Intent	Lost		VPI	Port	VPI	Port
6704864	N/A	N/A	0		87	1D1	87	1C1
8243008	N/A	N/A	0		95	1D2	95	1C3

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Cells Lost	The number of cells on this path that were dropped by the output network module.
CellsLost Intent	The number of cells dropped on this path due to EPD (Early Packet Discard) or PPD (Partial Packet Discard).
CellsLost Unintent	The number of cells dropped on this path due to output memory shortages or the CLP (Cell Loss Priority) threshold.
Cells Transmitted	The number of cells transmitted out this path for this priority.

If the connections are output on a Series D network module, then the display will vary depending on whether or not the module packet counter is disabled.

If the module packet counter is disabled, then the following is displayed:

mys	swit	ch::	statis	tics>	vpc traff	ic 1a1					
Ing	out		Outpu	.t	CellsTx		Cell	sLost			
Poi	rt.	VPI	Port	VPI	CLP0	CLP1	EPD	CLP0+1	CLP1	Unintent	Intent
1A1	L	1	1A2	1	0	0	N/A	0	0	0	N/A
1A1	L	2	1A3	2	0	0	N/A	0	0	0	N/A

If the module packet counter is enabled, then the following is displayed:

myswi	tch::	statis	tics>	vpc traff	fic 1a1					
Input		Outpu	.t	Cells Pa	ackets	Cell	sLost			
Port	VPI	Port	VPI	Tx	Tx	EPD	CLP0+1	CLP1	Unintent	Intent
1A1	1	1A2	1	0	0	N/A	0	0	0	N/A
1A1	2	1A3	2	0	0	N/A	0	0	0	N/A

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Cells Tx CLP0	The number of CLP=0 cells on this path that were transmitted.
Cells Tx CLP1	The number of CLP=1 cells on this path that were transmitted.
Packets Tx	The number of transmitted packets on this path.
Cells Lost EPD	The number of cells dropped on this path due to EPD (Early Packet Discard).
Cells Lost CLP0+1	The number of cells lost on this path due to the per-VC CLP=0+1 threshold.
Cells Lost CLP1	The number of cells lost on this path due to the per-VC CLP=1 threshold.
CellsLost Unintent	The number of cells dropped on this path due to output memory shortages or the per-port/per-priority CLP (Cell Loss Priority) thresholds.
CellsLost Intent	The number of cells dropped on this path due to PPD (Partial Packet Discard).

Field Description		
Input Port	The incoming port number.	
Input VPI	The incoming virtual path number.	
Output Port	The outgoing port number.	
Output VPI	The outgoing virtual path number.	
Qlen	The current queue length.	

4.30 VPT Statistics

You can display virtual path terminator statistics for an individual switch fabric by entering vpt at the statistics level as follows:



This command shows statistics for originating and terminating paths. To display statistics for through paths, use the stat vpc command.

myswi	tch::	statis	tics>	vpt		
Input		Outpu	.t		Cells	Cells
Port	VPI	Port	VPI	Uptime	Received	Rejected
1A1	0	termi	nate	0d:01:46	17716	0
1A2	0	termi	nate	0d:01:46	13962	0
1A3	0	termi	nate	0d:01:46	0	0
1A4	0	termi	nate	0d:01:46	0	0
1B1	0	termi	nate	0d:01:46	120685	0
1B2	0	termi	nate	0d:01:46	18767	0
1B3	0	termi	nate	0d:01:46	0	0
1B4	0	termi	nate	0d:01:46	121127	0
1CTL	0	termi	nate	0d:01:47	533219	0
origi	nate	1A1	0	0d:01:46	N/A	N/A
origi	nate	1A2	0	0d:01:46	N/A	N/A
origi	nate	1A3	0	0d:01:46	N/A	N/A
origi	nate	1A4	0	0d:01:46	N/A	N/A
Press return for more, q to quit: q						

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Uptime	The length of time that this virtual path has been in its current state.
Cells Received	The total (aggregate) number of cells that were transferred over this path.
Cells Rejected	The total (aggregate) number of cells over this path that were rejected (dropped) by the hardware due to a traffic policing violation. This does not include any cells that may have been tagged with CLP=1 by the policer, only cells that were discarded.

You can also display vpt statistics for just an individual port or path as follows:

myswi	nyswitch::statistics> vpt [<port> [<vpi>]]</vpi></port>						
myswitch::statistics>				vpt 1a2			
Input		Outpu	t		Cells	Cells	
Port	VPI	Port	VPI	Uptime	Received	Rejected	
1A2	0	termi	nate	0d:01:46	13962	0	
origi	nate	1A2	0	0d:01:46	N/A	N/A	

The fields in this display are defined in the same manner as those in the previous example.

You can also display fabric path counters for the vpts. Fabric path counters record the number of CAC (Connection Admission Control) failures, VPI allocation failures, VCI allocation failures, and connection setup errors for each path. Each path counter only records errors that occurred on that path. The counters are direction specific, meaning that errors that occurred on the input side are differentiated from errors that occurred on the output side. Enter the following parameters:

myswit	myswitch::statistics> vpt fabric						
Input		Outpu	.t	Fa	ilure	s	
Port	VPI	Port	VPI	CA	.C	VCI	Setup
2A1	0	termi	nate		0	0	0
2A2	0	termi	nate		0	0	0
2A3	0	termi	nate		0	0	0
2A4	0	termi	nate		0	50	0
2B1	0	termi	nate		0	0	0
2B2	0	termi	nate		0	1	0
2B3	0	termi	nate		0	0	0
2CTL	0	termi	nate		0	0	0
origin	nate	2A1	0		0	0	0
origin	nate	2A2	0		0	0	0
origin	nate	2A3	0		0	0	0
origin	nate	2A4	0		0	0	0
originate		2B1	0		0	0	0
origin	nate	2B2	0		0	0	0
Press	retu	rn for	more,	q to	quit	: q	

Field	Description
Input Port	Shows the incoming port number for a terminating path and shows originate for an originating path.

Field	Description
Input VPI	Shows the incoming virtual path number for a terminating path and shows originate for an originating path.
Output Port	Shows the outgoing port number for an originating path and shows terminate for a terminating path.
Output VPI	Shows the outgoing virtual path number for an originating path and shows terminate for a terminating path.
Failures CAC	The number of CAC (Connection Admission Control) failures on this path. If it is an elastic, terminating path, these failures occur if there is not enough bandwidth on the input path or link for the connection. If it is an elastic, originating path, these failures occur if there is not enough bandwidth on the output path or link for the connection.
Failures VCI	The number of VCI allocation failures on this path. These failures occur when an input VCI cannot be allocated because the VCI is already in use, because the VCI is out of range, or because no more VCIs are available for allocation on the path.
Failures Setup	The number of connection setup failures on this path. These failures occur if the connection cannot be set up on the fabric because the output network module cannot support the connection for various reasons, or because a connection ID cannot be allocated on on an ASX-1000 or TNX-1100 fabric.

You can also display vpt statistics for just an individual port or path as follows:

The fields in this display are defined in the same manner as those in the previous example.

Acronyms

The networking terms in the following list are defined in the Glossary of this manual. Glossary items are listed alphabetically according to the full term.

AAL ATM Adaptation Layer
ABR Available Bit Rate

ANA Available bit Rate

ACM Address Complete Message

ACR Allowable Cell Rate

ADPCM Adaptive Differential Pulse Code Modulation

AHFG ATM-attached Host Functional Group

AIMUX ATM Inverse Multiplexing
AIS Alarm Indication Signal
AMI Alternate Mark Inversion
AMI ATM Management Interface

ANSI American National Standards Institute
APCM Adaptive Pulse Code Modulation
API Application Program Interface

APP Application Program

APS Automatic Protection Switching
ARP Address Resolution Protocol

ASCII American Standard Code for Information Interchange

ATDM Asynchronous Time Division Multiplexing

ATM Asynchronous Transfer Mode
AUI Attachment User Interface
BBZS Bipolar 8 Zero Substitution

BCOB Broadband Connection Oriented Bearer

BCOB-A Bearer Class A
BCOB-C Bearer Class C
BCOB-X Bearer Class X

BECN Backward Explicit Congestion Notification

BER Bit Error Rate

BES Bursty Errored SecondsBGP Border Gateway ProtocolB-ISDN Inter-Carrier Interface.

BIP Bit Interleaved Parity

B-ISDN Broadband Integrated Services Digital Network

B-ISUP Broadband ISDN User's Part

Acronyms

BITS Building Integrated Timing Supply

BNC Bayonet-Neill-Concelman
BPDU Bridge Protocol Data Unit

bps Bits per SecondBPV Bipolar Violation

B-TE Broadband Terminal Equipment
BUS Broadcast and Unknown Server
CAC Connection Admission Control
CAS Channel Associated Signaling

CBDS Connectionless Broadband Data Service

CBR Constant Bit Rate

CCITT International Telephone and Telegraph Consultative Committee

CCS Common Channel Signaling

CDV Cell Delay Variation
CE Connection Endpoint

CEI Connection Endpoint Identifier
CES Circuit Emulation Service
CGA Carrier Group Alarm

CIP Carrier Identification Parameter
CIR Committed Information Rate

CLIP Classical IP
CLP Cell Loss Priority
CLR Cell Loss Ratio-1-15
CLS Connectionless service

CMIP Common Management Interface Protocol

CMR Cell Misinsertion Rate

CPE Customer Premise Equipment

CRA Cell Rate Adaptation
CRC Cyclic Redundancy Check

CRS Cell Relay Service
CS Controlled Slip, or

CSU Channel Service Unit
CTD Cell Transfer Delay
CTS Clear To Send

DACS Digital Access and Cross-Connect System
DARPA Defense Advanced Research Projects Agency

DCC Data Country Code

DCE Data Communications Equipment
DCS Digital Cross-connect System
DES Destination End Station

DFA DXI Frame Address

DLCI Data Link Connection Identifier

DNS Domain Naming System

DSn Digital Standard n (n=0, 1, 1C, 2, and 3)

DSR Data Set Ready

DTE Data Terminal Equipment
DTR Data Terminal Ready

EEPROM Electrically Erasable Programmable Read Only Memory

EFCI Explicit Forward Congestion Indication

EGP Exterior Gateway Protocol

EIA Electronics Industries Association

EISA Extended Industry Standard Architecture

EMI Emulated Local Area Network Electromagnetic Interference

EPROM Erasable Programmable Read Only Memory

EQL Equalization

ER Explicit Rate

ES End System, or

Errored Second

ESF Extended Super Frame **ESI** End System Identifier

EXZ Excessive Zeroes (Error Event)

FC Face Contact

FCC Federal Communications Commission

FCS Frame Check Sequence

FDDI Fiber Distributed Data Interface
FDM Frequency Division Multiplexing

FEE Far End Block Error
FEC Forward Error Correction

FECN Forward Explicit Congestion Notification

FERF Far End Receive Failure
FIFO First-In, First-Out
FRS Frame-Relay Service
FTP File Transfer Protocol
FT-PNNI ForeThought PNNI
FUNI Frame-Based UNI

GCAC Generic Connection Admission Control

GCRA Generic Cell Rate Algorithm

GFC Generic Flow Control HDB3 High Density Bipolar

HDLC High Level Data Link Control

HEC Header Error Control

HIPPI High Performance Parallel Interface

HSSI High-Speed Serial Interface

ICMP Internet Control Message Protocol

Acronyms

IDU Interface Data Unit

IEEE Institute of Electrical and Electronics Engineers

IETF Internet Engineering Task Force
ILMI Interim Local Management Interface

IP Internet Protocol

IPX Internetwork Packet Exchange

IS Intermediate system

ISDN Integrated Services Digital Network
ISO International Standards Organization

ITU-T International Telecommunication Union Telecommunication

IWF Interworking Function IXC Interexchange Carriers

JPEG Joint Photographic Experts Group

Kbps Kilobits per second
LAN Local Area Network
LANE LAN Emulation

LAPB Link Access Procedure, Balanced LATA Local Access and Transport Area

LINE Build Out
LINE Code Violations

LE_ARP LAN Emulation Address Resolution Protocol

LEC LAN Emulation Client

LECS LAN Emulation Configuration Server

LES LAN Emulation Server
LOC Logical Link Control
LOF Loss Of Frame
LOP Loss Of Pointer
LOS Loss Of Signal
LESB Least Significant Bit
MAC Media Access Control

MAC Media Access Control

MAN Metropolitan Area Network

MAU Media Attachment Unit

MBS Maximum Burst Size

MCDV Maximum Cell Delay Variance
MCLR Maximum Cell Loss Ratio

MCR Minimum Cell Rate

MCTDMaximum Cell Transfer DelayMIBManagement Information BaseMICMedia Interface Connector

MID Message Identifier

MMF Multimode Fiber Optic Cable
MPEG Motion Picture Experts Group
MPOA Multiprotocol over ATM

MSB Most Significant Bit

MTU Maximum Transmission Unit
NM Network Management Entity
NML Network Management Layer
NMS Network Management Station

NNI Network-to-Network Interface or Network Node Interface

NPC Network Parameter Control

NRZ Non Return to Zero

NRZI Non Return to Zero Inverted
NSAP Network Service Access Point
NTSC National TV Standards Committee
OAM Operation and Maintenance Cell

OC-n Optical Carrier level-n
OID Object Identifier
OOF Out-of-Frame

OSI Open Systems Interconnection
OSPF Open Shortest Path First Protocol
OUI Organizationally Unique Identifier
PAD Packet Assembler Disassembler

PAL Phase Alternate Line
PBX Private Branch Exchange

PCI Peripheral Component Interconnect

PCM Pulse Code Modulation

PCR Peak Cell Rate

PDN Public Data Network
PDU Protocol Data Unit
PHY Physical Layer

ping Packet Internet Groper

PLCP Physical Layer Convergence Protocol

PLP Packet Level Protocol PM Physical Medium

PMD Physical Medium Dependent

PNNI Private Network Node Interface or Private Network-to-Network Interface

PPP Point-to-Point Protocol

PROM Programmable Read-Only Memory

PRS Primary Reference Source
PSN Packet Switched Network

PT Payload Type

PVC Permanent Virtual Circuit (or Channel)
PVCC Permanent Virtual Channel Connection
PVPC Permanent Virtual Path Connection

QD Queuing Delay
QoS Quality of Service

Acronyms

RD Routing Domain
RFCs Requests For Comment
RFI Radio Frequency Interference
RIP Routing Information Protocol
RISC Reduced Instruction Set Computer

RTS Request To Send
SA Source Address
SA Source MAC Address
SAP Service Access Point

SAR Segmentation And Reassembly

SC Structured Cabling, or

Structured Connectors, or

Stick and Click

SCR Sustainable Cell Rate

SCSI Small Computer Systems Interface
SDLC Synchronous Data Link Control

SDU Service Data Unit

SEAL Simple and Efficient Adaptation Layer
SECAM Systeme En Coleur Avec Memoire

SEL Selector

SES Severely Errored Seconds

SF Super Frame

SGMP Simple Gateway Management Protocol

SIR Sustained Information Rate

SLIP Serial Line IP

SMDS Switched Multimegabit Data Service

SMF Single Mode Fiber

SMTP Simple Mail Transfer Protocol
SNA Systems Network Architecture
SNAP SubNetwork Access Protocol
SNI Subscriber Network Interface

SNMP Simple Network Management Protocol

SONET Synchronous Optical Network

SPANS Simple Protocol for ATM Network Signalling

SPARC Scalable Processor Architecture Reduced instruction set Computer

SPE Synchronous Payload Envelope

SPVC Smart PVC

SS7 Signaling System No. 7

SSCOP Service Specific Connection Oriented Protocol

SSCS Service Specific Convergence Sublayer

ST Straight Tip, or

Stick and Turn

STM Synchronous Transfer Mode

STP Shielded Twisted Pair, Spanning Tree Protocol

STS Synchronous Transport Signal

SVC Switched Virtual Circuit (or Channel)
SVCC Switched Virtual Channel Connection
SVPC Switched Virtual Path Connection

TAXI Transparent Asynchronous Transmitter/Receiver Interface

TC Transmission Convergence
TCP Transmission Control Protocol

TCP/IP Transmission Control Protocol/Internet Protocol

TCR Tagged Cell Rate

TCS Transmission Convergence Sublayer

TDM Time Division Multiplexing

TE Terminal Equipment

TFTP Trivial File Transfer Protocol

TM Traffic Management
UAS Unavailable Seconds
UBR Unspecified Bit Rate
UDP User Datagram Protocol
UNI User-to-Network Interface
UPC Usage Parameter Control

UTOPIA Universal Test & Operations Interface for ATM

UTP Unshielded Twisted Pair

VBR Variable Bit Rate

VC Virtual Channel (or Circuit)
VCC Virtual Channel Connection
VCI Virtual Channel Identifier
VCL Virtual Channel Link
VINES Virtual Network Software
VLAN Virtual Local Area Network

VP Virtual Path

VPC Virtual Path Connection
VPDN Virtual Private Data Network

VPI Virtual Path Identifier
VPL Virtual Path Link
VPN Virtual Private Network
VPT Virtual Path Terminator

VS/VD Virtual Source/Virtual Destination

VT Virtual Tributary
WAN Wide-Area Network

ZBTSI Zero Byte Time Slot Interchange

Acronyms

Glossary

10Base-T - a 10 Mbps baseband Ethernet specification utilizing twisted-pair cabling (Category 3, 4, or 5). 10BaseT, which is part of the IEEE 802.3 specification, has a distance limit of approximately 100 meters per segment.

802.1d Spanning Tree Bridging - the IEEE standard for bridging; a MAC layer standard for transparently connecting two or more LANs (often called subnetworks) that are running the same protocols and cabling. This arrangement creates an extended network, in which any two workstations on the linked LANs can share data.

802.3 Ethernet - the IEEE standard for Ethernet; a physical-layer standard that uses the CSMA/CD access method on a bus-topology LAN.

802.5 Token Ring - the IEEE physical-layer standard that uses the token-passing access method on a ring-topology LAN.

AAL Connection - an association established by the AAL between two or more next higher layer entities.

Adapter - A fitting that supplies a passage between two sets of equipment when they cannot be directly interconnected.

Adaptive Differential Pulse Code Modulation (ADPCM) - A technique that allows analog voice signals to be carried on a 32K bps digital channel. Sampling is done at 8Hz with 4 bits used to describe the difference between adjacent samples.

Adaptive Pulse Code Modulation (APCM) - A technique that effectively reduces occupied bandwidth per active speaker by reducing sampling rates during periods of overflow peak traffic.

Address - A unique identity of each network station on a LAN or WAN.

 $\label{lem:Address Complete Message (ACM) - A B-ISUP call control message from the receiving exchange to sending exchange indicating the completion of address information.}$

Address Mask - a bit mask used to identify which bits in an address (usually an IP address) are network significant, subnet significant, and host significant portions of the complete address. This mask is also known as the subnet mask because the subnetwork portion of the address can be determined by comparing the binary version of the mask to an IP address in that subnet. The mask holds the same number of bits as the protocol address it references.

Address Prefix - A string of 0 or more bits up to a maximum of 152 bits that is the lead portion of one or more ATM addresses.

Address Resolution - The procedure by which a client associates a LAN destination with the ATM address of another client or the BUS.

Address Resolution Protocol (ARP) - a method used to resolve higher level protocol addressing (such as IP) into the appropriate header data required for ATM; i.e., port, VPI, and VCI; also defines the AAL type to be used.

Agent - a component of network- and desktop-management software, such as SNMP, that gathers information from MIBs.

alarm - an unsolicited message from a device, typically indicating a problem with the system that requires attention.

Alarm Indication Signal (AIS) - In T1, an all ones condition used to alert a receiver that its incoming signal (or frame) has been lost. The loss of signal or frame is detected at the receiving end, and the failed signal is replaced by all the ones condition which the receiver interprets as an AIS. The normal response to this is AIS is for the receiving end to generate a yellow alarm signal as part of its transmission towards the faulty end. (The AIS itself is sometimes called a Blue Signal).

A-Law - The PCM coding and companding standard used in Europe.

Allowable Cell Rate (ACR) - parameter defined by the ATM Forum for ATM traffic management. ACR varies between the MCR and the PCR, and is dynamically controlled using congestion control mechanisms.

Alternate Mark Inversion (AMI) - A line coding format used on T1 facilities that transmits ones by alternate positive and negative pulses.

Alternate Routing - A mechanism that supports the use of a new path after an attempt to set up a connection along a previously selected path fails.

American National Standards Institute (ANSI) - a private organization that coordinates the setting and approval of some U.S. standards. It also represents the United States to the International Standards Organization.

American Standard Code for Information Interchange (ASCII) - a standard character set that (typically) assigns a 7-bit sequence to each letter, number, and selected control characters.

AppleTalk - a networking protocol developed by Apple Computer for communication between Apple's products and other computers. Independent of the network layer, AppleTalk runs on LocalTalk, EtherTalk and TokenTalk.

Application Layer - Layer seven of the ISO reference model; provides the end-user interface.

Application Program (APP) - a complete, self-contained program that performs a specific function directly for the user.

Application Program Interface (API) - a language format that defines how a program can be made to interact with another program, service, or other software; it allows users to develop custom interfaces with FORE products.

Assigned Cell - a cell that provides a service to an upper layer entity or ATM Layer Management entity (ATMM-entity).

asxmon - a FORE program that repeatedly displays the state of the switch and its active ports.

Asynchronous Time Division Multiplexing (ATDM) - a multiplexing technique in which a transmission capability is organized into a priori, unassigned time slots. The time slots are assigned to cells upon request of each application's instantaneous real need.

Asynchronous Transfer Mode (ATM) - a transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic.

ATM Adaptation Layer (AAL) - the AAL divides user information into segments suitable for packaging into a series of ATM cells. AAL layer types are used as follows:

AAL-1 - constant bit rate, time-dependent traffic such as voice and video

AAL-2 - still undefined; a placeholder for variable bit rate video transmission

AAL-3/4 - variable bit rate, delay-tolerant data traffic requiring some sequencing and/or error detection support (originally two AAL types, connection-oriented and connectionless, which have been combined)

AAL-5 - variable bit rate, delay-tolerant, connection-oriented data traffic requiring minimal sequencing or error detection support

ATM Address - Defined in the UNI Specification as 3 formats, each having 20 bytes in length.

ATM Forum - an international non-profit organization formed with the objective of accelerating the use of ATM products and services through a rapid convergence of interoperability specifications. In addition, the Forum promotes industry cooperation and awareness.

ATM Inverse Multiplexing (AIMUX) - A device that allows multiple T1 or E1 communications facilities to be combined into a single broadband facility for the transmission of ATM cells.

ATM Layer link - a section of an ATM Layer connection between two adjacent active ATM Layer entities (ATM-entities).

ATM Link - a virtual path link (VPL) or a virtual channel link (VCL).

ATM Management Interface (AMI) - the user interface to FORE Systems' *ForeThought* switch control software (SCS). AMI lets users monitor and change various operating configurations of FORE Systems switches and network module hardware and software, IP connectivity, and SNMP network management.

ATM Peer-to-Peer Connection - a virtual channel connection (VCC) or a virtual path connection (VPC) directly established, such as workstation-to-workstation. This setup is not commonly used in networks.

ATM Traffic Descriptor - a generic list of parameters that can be used to capture the intrinsic traffic characteristics of a requested ATM connection.

ATM User-to-User Connection - an association established by the ATM Layer to support communication between two or more ATM service users (i.e., between two or more next higher layer entities or between two or more ATM entities). The communication over an ATM Layer connection may be either bidirectional or unidirectional. The same Virtual Channel Identifier (VCI) is used for both directions of a connection at an interface.

atmarp - a FORE program that shows and manipulates ATM ARP entries maintained by the given device driver. This is also used to establish PVC connections.

ATM-attached Host Functional Group (AHFG) - The group of functions performed by an ATM-attached host that is participating in the MPOA service.

atmconfig - a FORE program used to enable or disable SPANS signalling.

atmstat - a FORE program that shows statistics gathered about a given adapter card by the device driver. These statistics include ATM layer and ATM adaptation layer cell and error counts. This can also be used to query other hosts via SNMP.

Attachment User Interface (AUI) - IEEE 802.3 interface between a media attachment unit (MAU) and a network interface card (NIC). The term AUI can also refer to the rear panel port to which an AUI cable might attach.

Auto-logout - a feature that automatically logs out a user if there has been no user interface activity for a specified length of time.

Automatic Protection Switching (APS) - Equipment installed in communications systems to detect circuit failures and automatically switch to redundant, standby equipment.

Available Bit Rate (ABR) - a type of traffic for which the ATM network attempts to meet that traffic's bandwidth requirements. It does not guarantee a specific amount of bandwidth and the end station must retransmit any information that did not reach the far end.

Backbone - the main connectivity device of a distributed system. All systems that have connectivity to the backbone connect to each other, but systems can set up private arrangements with each other to bypass the backbone to improve cost, performance, or security.

Backplane - High-speed communications line to which individual components are connected.

Backward Explicit Congestion Notification (BECN) - A Resource Management cell type generated by the network or the destination, indicating congestion or approaching congestion for traffic flowing in the direction opposite that of the BECN cell.

Bandwidth - usually identifies the capacity or amount of data that can be sent through a given circuit; may be user-specified in a PVC.

Baud - unit of signalling speed, equal to the number of discrete conditions or signal events per second. If each signal event represents only one bit, the baud rate is the same as bps; if each signal event represents more than one bit (such as a dibit), the baud rate is smaller than bps.

Bayonet-Neill-Concelman (BNC) - a bayonet-locking connector used to terminate coaxial cables. BNC is also referred to as Bayonet Network Connector.

Bipolar 8 Zero Substitution (B8ZS) - a technique used to satisfy the ones density requirements of digital T-carrier facilities in the public network while allowing 64 Kbps clear channel data. Strings of eight consecutive zeroes are replaced by an eight-bit code representing two intentional bipolar pulse code violations (000V10V1).

Bipolar Violation (BPV) - an error event on a line in which the normal pattern of alternating high (one) and low (zero) signals is disrupted. A bipolar violation is noted when two high signals occur without an intervening low signal, or vice versa.

B-ISDN Inter-Carrier Interface (B-ICI) - An ATM Forum defined specification for the interface between public ATM networks to support user services across multiple public carriers.

Bit Error Rate (BER) - A measure of transmission quality, generally shown as a negative exponent, (e.g., 10^{-7} which means 1 out of 10^{7} bits [1 out of 10,000,000 bits] are in error).

Bit Interleaved Parity (BIP) - an error-detection technique in which character bit patterns are forced into parity, so that the total number of one bits is always odd or always even. This is accomplished by the addition of a one or zero bit to each byte, as the byte is transmitted; at the other end of the transmission, the receiving device verifies the parity (odd or even) and the accuracy of the transmission.

Bit Robbing - The use of the least significant bit per channel in every sixth frame for signaling.

Bit Stuffing - A process in bit-oriented protocols where a zero is inserted into a string of ones by the sender to prevent the receiver from interpreting valid user data (the string of ones) as control characters (a Flag character for instance).

Border Gateway Protocol (BGP) - used by gateways in an internet connecting autonomous networks. It is derived from experiences learned using the EGP.

bps - bits per second

Bridge - a device that expands a Local Area Network by forwarding frames between data link layers associated with two separate cables, usually carrying a common protocol. Bridges can usually be made to filter certain packets (to forward only certain traffic).

Bridge Protocol Data Unit (BPDU) - A message type used by bridges to exchange management and control information.

Broadband - a service or system requiring transmission channels capable of supporting rates greater than the Integrated Services Digital Network (ISDN) primary rate.

Broadband Access - an ISDN access capable of supporting one or more broadband services.

Broadband Connection Oriented Bearer (BCOB) - Information in the SETUP message that indicates the type of service requested by the calling user.

BCOB-A (Bearer Class A) - Indicated by ATM end user in SETUP message for connection-oriented, constant bit rate service. The network may perform internetworking based on AAL information element (IE).

BCOB-C (Bearer Class C) - Indicated by ATM end user in SETUP message for connection-oriented, variable bit rate service. The network may perform internetworking based on AAL information element (IE).

BCOB-X (Bearer Class X) - Indicated by ATM end user in SETUP message for ATM transport service where AAL, traffic type and timing requirements are transparent to the network.

Broadband Integrated Services Digital Network (B-ISDN) - a common digital network suitable for voice, video, and high-speed data services running at rates beginning at 155 Mbps.

Broadband ISDN User's Part (B-ISUP) - A protocol used to establish, maintain and release broadband switched network connections across an SS7/ATM network.

Broadband Terminal Equipment (B-TE) - An equipment category for B-ISDN which includes terminal adapters and terminals.

Broadcast - Data transmission to all addresses or functions.

Broadcast and Unknown Server (BUS) - in an emulated LAN, the BUS is responsible for accepting broadcast, multicast, and unknown unicast packets from the LECs to the broadcast MAC address (FFFFFFFFFF) via dedicated point-to-point connections, and forwarding the packets to all of the members of the ELAN using a single point-to-multipoint connection.

Brouter (bridging/router) - a device that routes some protocols and bridges others based on configuration information.

Buffer - A data storage medium used to compensate of a difference in rate of data flow or time of occurrence of events when transmitting data from one device to another.

Building Integrated Timing Supply (BITS) - a master timing supply for an entire building, which is a master clock and its ancillary equipment. The BITS supplies DS1 and/or composite clock timing references for synchronization to all other clocks and timing sources in that building.

Bursty Errored Seconds (BES) - a BES contains more than 1 and fewer than 320 path coding violation error events, and no severely errored frame or AIS defects. Controlled slips are not included in determining BESs.

Bursty Second - a second during which there were at least the set number of BES threshold event errors but fewer than the set number of SES threshold event errors.

Byte - A computer-readable group of bits (normally 8 bits in length).

Call - an association between two or more users or between a user and a network entity that is established by the use of network capabilities. This association may have zero or more connections.

Carrier - a company, such as any of the "baby Bell" companies, that provide network communications services, either within a local area or between local areas.

Carrier Group Alarm (CGA) - A service alarm generated by a channel bank when an out-of-frame (OOF) condition exists for some predetermined length of time (generally 300 milliseconds to 2.5 seconds). The alarm causes the calls using a trunk to be dropped and trunk conditioning to be applied.

Carrier Identification Parameter (CIP) - A 3 or 4 digit code in the initial address message identifying the carrier to be used for the connection.

cchan - a FORE program that manages virtual channels on a *ForeRunner* switch running asxd.

Cell - an ATM Layer protocol data unit (PDU). The basic unit of information transported in ATM technology, each 53-byte cell contains a 5-byte header and a 48-byte payload.

Cell Delay Variation (CDV) - a quantification of cell clumping for a connection. The cell clumping CDV (yk) is defined as the difference between a cell's expected reference arrival time (ck) and its actual arrival time (ak). The expected reference arrival time (ck) of cell k of a specific connection is max. T is the reciprocal of the negotiated peak cell rate.

Cell Delineation - the protocol for recognizing the beginning and end of ATM cells within the raw serial bit stream.

Cell Header - ATM Layer protocol control information.

Cell Loss Priority (CLP) - the last bit of byte four in an ATM cell header; indicates the eligibility of the cell for discard by the network under congested conditions. If the bit is set to 1, the cell may be discarded by the network depending on traffic conditions.

Cell Loss Ratio - In a network, cell loss ratio is (1-x/y), where y is the number of cells that arrive in an interval at an ingress of the network; and x is the number of these y cells that leave at the egress of the network element.

Cell Loss Ratio (CLR) - CLR is a negotiated QoS parameter and acceptable values are network specific. The objective is to minimize CLR provided the end-system adapts the traffic to the changing ATM layer transfer characteristics. The Cell Loss Ratio is defined for a connection as: Lost Cells/Total Transmitted Cells. The CLR parameter is the value of CLR that the network agrees to offer as an objective over the lifetime of the connection. It is expressed as an order of magnitude, having a range of 10-1 to 10-15 and unspecified.

Cell Misinsertion Rate (CMR) - the ratio of cells received at an endpoint that were not originally transmitted by the source end in relation to the total number of cells properly transmitted.

Cell Rate Adaptation (CRA) - a function performed by a protocol module in which empty cells (known as unassigned cells) are added to the output stream. This is because there always must be a fixed number of cells in the output direction; when there are not enough cells to transmit, unassigned cells are added to the output data stream.

Cell Relay Service (CRS) - a carrier service which supports the receipt and transmission of ATM cells between end users in compliance with ATM standards and implementation specifications.

Cell Transfer Delay - the transit delay of an ATM cell successfully passed between two designated boundaries. See CTD.

Cell Transfer Delay (CTD) - This is defined as the elapsed time between a cell exit event at the measurement point 1 (e.g., at the source UNI) and the corresponding cell entry event at the measurement point 2 (e.g., the destination UNI) for a particular connection. The cell transfer delay between two measurement points is the sum of the total inter-ATM node transmission delay and the total ATM node processing delay.

Channel - A path or circuit along which information flows.

Channel Associated Signaling (CAS) - a form of circuit state signaling in which the circuit state is indicated by one or more bits of signaling status sent repetitively and associated with that specific circuit.

Channel Bank - A device that multiplexes many slow speed voice or data conversations onto high speed link and controls the flow.

Channel Service Unit (CSU) - An interface for digital leased lines which performs loopback testing and line conditioning.

Channelization - capability of transmitting independent signals together over a cable while still maintaining their separate identity for later separation.

Circuit - A communications link between points.

Circuit Emulation Service (CES) - The ATM Forum circuit emulation service interoperability specification specifies interoperability agreements for supporting Constant Bit Rate (CBR) traffic over ATM networks that comply with the other ATM Forum interoperability agreements. Specifically, this specification supports emulation of existing TDM circuits over ATM networks.

Classical IP (CLIP) - IP over ATM which conforms to RFC 1577.

Clear to Send (CTS) - and RS-232 modem interface control signal (sent from the modem to the DTE on pin 5) which indicates that the attached DTE may begin transmitting; issuance in response to the DTE's RTS.

Clocking - Regularly timed impulses.

Closed User Group - A subgroup of network users that can be its own entity; any member of the subgroup can only communicate with other members of that subgroup.

Coaxial Cable - Coax is a type of electrical communications medium used in the LAN environment. This cable consists of an outer conductor concentric to an inner conductor, separated from each other by insulating material, and covered by some protective outer material. This medium offers large bandwidth, supporting high data rates with high immunity to electrical interference and a low incidence of errors. Coax is subject to distance limitations and is relatively expensive and difficult to install.

Cold Start Trap - an SNMP trap which is sent after a power-cycle (see *trap*).

Collision - Overlapping transmissions that occur when two or more nodes on a LAN attempt to transmit at or about the same time.

Committed Information Rate (CIR) - CIR is the information transfer rate which a network offering Frame Relay Services (FRS) is committed to transfer under normal conditions. The rate is averaged over a minimum increment of time.

Common Channel Signaling (CCS) - A form signaling in which a group of circuits share a signaling channel. Refer to SS7.

Common Management Interface Protocol (CMIP) - An ITU-TSS standard for the message formats and procedures used to exchange management information in order to operate, administer maintain and provision a network.

Concatenation - The connection of transmission channels similar to a chain.

Concentrator - a communications device that offers the ability to concentrate many lower-speed channels into and out of one or more high-speed channels.

Configuration - The phase in which the LE Client discovers the LE Service.

Congestion Management - traffic management feature that helps ensure reasonable service for VBR connections in an ATM network, based on a priority, sustained cell rate (SCR), and peak cell rate (PCR). During times of congestion, bandwidth is reduced to the SCR, based on the priority of the connection.

Connection - the concatenation of ATM Layer links in order to provide an end-to-end information transfer capability to access points.

Connection Admission Control (CAC) - the procedure used to decide if a request for an ATM connection can be accepted based on the attributes of both the requested connection and the existing connections.

Connection Endpoint (CE) - a terminator at one end of a layer connection within a SAP.

Connection Endpoint Identifier (CEI) - an identifier of a CE that can be used to identify the connection at a SAP.

Connectionless Broadband Data Service (CBDS) - A connectionless service similar to Bellcore's SMDS defined by European Telecommunications Standards Institute (ETSI).

Connectionless Service - a type of service in which no pre-determined path or link has been established for transfer of information, supported by AAL 4.

Connectionless Service (CLS) - A service which allows the transfer of information among service subscribers without the need for end-to- end establishment procedures.

Connection-Oriented Service - a type of service in which information always traverses the same pre-established path or link between two points, supported by AAL 3.

Constant Bit Rate (CBR) - a type of traffic that requires a continuous, specific amount of bandwidth over the ATM network (e.g., digital information such as video and digitized voice).

Controlled Slip (CS) - a situation in which one frame's worth of data is either lost or replicated. A controlled slip typically occurs when the sending device and receiving device are not using the same clock.

Convergence Sublayer (CS) - a portion of the AAL. Data is passed first to the CS where it is divided into rational, fixed-length packets or PDUs (Protocol Data Units). For example, AAL 4 processes user data into blocks that are a maximum of 64 kbytes long.

Corresponding Entities - peer entities with a lower layer connection among them.

cpath - a FORE program used to manage virtual paths on a ForeRunner switch running asxd.

cport - a FORE program that monitors and changes the state of ports on a *ForeRunner* switch running asxd.

Cross Connection - a mapping between two channels or paths at a network device.

Customer Premise Equipment (CPE) - equipment that is on the customer side of the point of demarcation, as opposed to equipment that is on a carrier side. See also point of demarcation.

Cut Through - Establishment of a complete path for signaling and/or audio communications.

Cyclic Redundancy Check (CRC) - an error detection scheme in which a number is derived from the data that will be transmitted. By recalculating the CRC at the remote end and comparing it to the value originally transmitted, the receiving node can detect errors.

D3/D4 - Refers to compliance with AT&T TR (Technical Reference) 62411 definitions for coding, supervision, and alarm support. D3/D4 compatibility ensures support of digital PBXes, M24 services, Megacom services, and Mode 3 D3/D4 channel banks at DS-1 level.

D4 Channelization - refers to compliance with AT&T Technical Reference 62411 regarding DS1 frame layout (the sequential assignment of channels and time slot numbers within the DS1).

D4 Framed/Framing Format - in T1, a 193-bit frame format in which the 193rd bit is used for framing and signaling information (the frame/framing bit). To be considered in support of D4 Framing, a device must be able to synchronize and frame-up on the 193rd bit.

Data Communications Equipment (DCE) - a definition in the RS232C standard that describes the functions of the signals and the physical characteristics of an interface for a communication device such as a modem.

Data Country Code (DCC) - This specifies the country in which an address is registered. The codes are given in ISO 3166. The length of this field is two octets. The digits of the data country code are encoded in Binary Coded Decimal (BCD) syntax. The codes will be left justified and padded on the right with the hexadecimal value "F" to fill the two octets.

Data Link - Communications connection used to transmit data from a source to a destination.

Data Link Connection Identifier (DLCI) - connection identifier associated with frame relay packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

Data Link Layer - Layer 2 of the OSI model, responsible for encoding data and passing it to the physical medium. The IEEE divides this layer into the LLC (Logical Link Control) and MAC (Media Access Control) sublayers.

Data Set Ready (DSR) - an RS-232 modem interface control signal (sent from the modem to the DTE on pin 6) which indicates that the modem is connected to the telephone circuit. Usually a prerequisite to the DTE issuing RTS.

Data Terminal Equipment (DTE) - generally user devices, such as terminals and computers, that connect to data circuit-terminating equipment. They either generate or receive the data carried by the network.

Data Terminal Ready (DTR) - an RS232 modem interface control signal (sent from the DTE to the modem on pin 20) which indicates that the DTE is ready for data transmission and which requests that the modem be connected to the telephone circuit.

Datagram - a packet of information used in a connectionless network service that is routed to its destination using an address included in the datagram's header.

DECnet - Digital Equipment Corporation's proprietary LAN.

Defense Advanced Research Projects Agency (DARPA) - the US government agency that funded the ARPANET.

Demultiplexing - a function performed by a layer entity that identifies and separates SDUs from a single connection to more than one connection (see *multiplexing*).

Destination End Station (DES) - An ATM termination point which is the destination for ATM messages of a connection and is used as a reference point for ABR services. See SES.

Digital Access and Cross-Connect System (DACS) - Digital switching system for routing T1 lines, and DS-0 portions of lines, among multiple T1 ports.

Digital Cross-connect System (DCS) - an electronic patch panel used to route digital signals in a central office.

Digital Standard n (0, 1, 1C, 2, and 3) (DSn) - a method defining the rate and format of digital hierarchy, with asynchronous data rates defined as follows:

DS0	64kb/s	1 voice channel
DS1	1.544Mb/s	24 DS0s
DS1C	3.152 Mb/s	2 DS1s
DS2	6.312 Mb/s	4 DS1s
DS3	44.736 Mb/s	28 DS1s

Synchronous data rates (SONET) are defined as:

STS-1/OC-1	51.84 Mb/s	28 DS1s or 1 DS3
STS-3/OC-3	155.52 Mb/s	3 STS-1s byte interleaved
STS-3c/OC-3c	155.52 Mb/s	Concatenated, indivisible payload
STS-12/OC-12	622.08 Mb/s	12 STS-1s, 4 STS-3cs, or any mixture
STS-12c/OC-12c	622.08 Mb/s	Concatenated, indivisible payload
STS-48/OC-48	2488.32 Mb/s	48 STS-1s, 16 STS-3cs, or any mixture

DIP (Dual In-line Package) Switch - a device that has two parallel rows of contacts that let the user switch electrical current through a pair of those contacts to on or off. They are used to reconfigure components and peripherals.

Domain Name Server - a computer that converts names to their corresponding Internet numbers. It allows users to telnet or FTP to the name instead of the number.

Domain Naming System (DNS) - the distributed name and address mechanism used in the Internet.

Duplex - Two way communication.

DXI - a generic phrase used in the full names of several protocols, all commonly used to allow a pair of DCE and DTE devices to share the implementation of a particular WAN protocol. The protocols define the packet formats used to transport data between DCE and DTE devices.

DXI Frame Address (DFA) - a connection identifier associated with ATM DXI packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

Dynamic Allocation - A technique in which the resources assigned for program execution are determined by criteria applied at the moment of need.

E.164 - A public network addressing standard utilizing up to a maximum of 15 digits. ATM uses E.164 addressing for public network addressing.

E1 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 2.048 Mbps. E1 lines can be leased for private use from common carriers.

E3 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 34.368 Mbps. E3 lines can be leased for private use from common carriers.

Edge Device - A physical device which is capable of forwarding packets between legacy interworking interfaces (e.g., Ethernet, Token Ring, etc.) and ATM interfaces based on data-link and network layer information but which does not participate in the running of any network layer routing protocol. An Edge Device obtains forwarding descriptions using the route distribution protocol.

elarp - a FORE program that shows and manipulates MAC and ATM address mappings for LAN Emulation Clients (LECs).

elconfig - a FORE program that shows and modifies LEC configuration. Lets the user set the NSAP address of the LAN Emulation Configuration Server, display the list of Emulated LANs configured in the LECS for this host, display the list of ELANs locally configured along with the membership state of each, and locally administer ELAN membership.

Electrically Erasable Programmable Read Only Memory (EEPROM) - an EPROM that can be cleared with electrical signals rather than the traditional ultraviolet light.

Electromagnetic Interference (EMI) - signals generated and radiated by an electronic device that cause interference with radio communications, among other effects.

Electronics Industries Association (EIA) - a USA trade organization that issues its own standards and contributes to ANSI; developed RS-232. Membership includes USA manufacturers.

Embedded SNMP Agent - an SNMP agent can come in two forms: embedded or proxy. An embedded SNMP agent is integrated into the physical hardware and software of the unit.

Emulated Local Area Network (ELAN) - A logical network initiated by using the mechanisms defined by LAN Emulation. This could include ATM and legacy attached end stations.

End System (ES) - a system where an ATM connection is terminated or initiated (an originating end system initiates the connection).

End System Identifier (ESI) - This identifier distinguishes multiple nodes at the same level in case the lower level peer group is partitioned.

End-to-End Connection - when used in reference to an ATM network, a connection that travels through an ATM network, passing through various ATM devices and with endpoints at the termination of the ATM network.

Enterprise - Terminology generally referring to customers with multiple, non-contiguous geographic locations.

Equalization (EQL) - the process of compensating for line distortions.

Erasable Programmable Read Only Memory (EPROM) - A PROM which may be erased and rewritten to perform new or different functions (normally done with a PROM burner).

Errored Second (ES) - a second during which at least one code violation occurred.

Ethernet - a 10-Mbps, coaxial standard for LANs in which all nodes connect to the cable where they contend for access.

Excessive Zeroes (EXZ) Error Event - An Excessive Zeroes error event for an AMI-coded signal is the occurrence of more than fifteen contiguous zeroes. For a B8ZS coded signal, the defect occurs when more than seven contiguous zeroes are detected.

Explicit Forward Congestion Indication (EFCI) - the second bit of the payload type field in the header of an ATM cell, the EFCI bit indicates network congestion to receiving hosts. On a congested switch, the EFCI bit is set to "1" by the transmitting network module when a certain number of cells have accumulated in the network module's shared memory buffer. When a cell is received that has its EFCI bit set to "1," the receiving host notifies the sending host, which should then reduce its transmission rate.

Explicit Rate (ER) - The Explicit Rate is an RM-cell field used to limit the source ACR to a specific value. It is initially set by the source to a requested rate (such as PCR). It may be subsequently reduced by any network element in the path to a value that the element can sustain. ER is formatted as a rate.

Extended Industry Standard Architecture (EISA) - bus architecture for desktop computers that provides a 32-bit data passage and maintains compatibility with the ISA or AT architecture.

Extended Super Frame (ESF) - a T1 framing format that utilizes the 193rd bit as a framing bit, but whose Superframe is made up of 24 frames instead of 12 as in D4 format. ESF also provides CRC error detection and maintenance data link functions.

Exterior Gateway Protocol (EGP) - used by gateways in an internet, connecting autonomous networks.

Fairness - related to Generic Flow Control, fairness is defined as meeting all of the agreed quality of service requirements by controlling the order of service for all active connections.

Far End Block Error (FEBE) - an error detected by extracting the 4-bit FEBE field from the path status byte (G1). The legal range for the 4-bit field is between 0000 and 1000, representing zero to eight errors. Any other value is interpreted as zero errors.

Far End Receive Failure (FERF) - a line error asserted when a 110 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. A line FERF is removed when any pattern other than 110 is detected in these bits for five consecutive frames.

Far-End - in a relationship between two devices in a circuit, the far-end device is the one that is remote.

Face Contact (FC) - Designation for fiber optic connector designed by Nippon Telegraph and Telephone which features a movable anti-rotation key allowing good repeatable performance despite numerous mating. Normally referred to as Fiber Connector, FC actually stands for Face Contact and sometimes linked with PC (Point Contact), designated as FC or FC-PC.

FCC Part 68 - The FCC rules regulating the direct connection of non-telephone company provided equipment to the public telephone network.

Federal Communications Commission (FCC) - a board of commissioners appointed by the President under the Communications Act of 1934, with the authority to regulate all interstate telecommunications originating in the United States, including transmission over phone lines.

Fiber Distributed Data Interface (FDDI) - high-speed data network that uses fiber-optic as the physical medium. Operates in similar manner to Ethernet or Token Ring, only faster.

File Transfer Protocol (FTP) - a TCP/IP protocol that lets a user on one computer access, and transfer data to and from, another computer over a network. ftp is usually the name of the program the user invokes to accomplish this task.

First-In, First-Out (FIFO) - method of coordinating the sequential flow of data through a buffer.

Flag - a bit pattern of six binary "1"s bounded by a binary "0" at each end (forms a 0111 1110 or Hex "7E"). It is used to mark the beginning and/or end of a frame.

Flow Control - The way in which information is controlled in a network to prevent loss of data when the receiving buffer is near its capacity.

ForeThought PNNI (FT-PNNI) - a FORE Systems routing and signalling protocol that uses private ATM (NSAP) addresses; a precursor to ATM Forum PNNI (see PNNI).

Forward Error Correction (FEC) - A technique used by a receiver for correcting errors incurred in transmission over a communications channel without requiring retransmission of any information by the transmitter; typically involves a convolution of the transmitted bits and the appending of extra bits by both the receiver and transmitter using a common algorithm.

Forward Explicit Congestion Notification (FECN) - Bit set by a Frame Relay network to inform data terminal equipment (DTE) receiving the frame that congestion was experienced in the path from source to destination. DTE receiving frames with the FECN bit set can request that higher-level protocols take flow control action as appropriate.

Fractional T1 - the use of bandwidth in 64Kbps increments up to 1.544Mbps from a T1 facility.

Frame - a variable length group of data bits with a specific format containing flags at the beginning and end to provide demarcation.

Frame Check Sequence (FCS) - In bit-oriented protocols, a 16-bit field that contains transmission error checking information, usually appended to the end of the frame.

Frame Relay - a fast packet switching protocol based on the LAPD protocol of ISDN that performs routing and transfer with less overhead processing than X.25.

Frame Synchronization Error - an error in which one or more time slot framing bits are in error.

Frame-Based UNI (FUNI) - An ATM switch-based interface which accepts frame-based ATM traffic and converts it into cells.

Frame-Relay Service (FRS) - A connection oriented service that is capable of carrying up to 4096 bytes per frame.

Framing - a protocol that separates incoming bits into identifiable groups so that the receiving multiplexer recognizes the grouping.

Frequency Division Multiplexing (FDM) - a method of dividing an available frequency range into parts with each having enough bandwidth to carry one channel.

Gbps - gigabits per second (billion)

Generic Cell Rate Algorithm (GCRA) - an algorithm which is employed in traffic policing and is part of the user/network service contract. The GCRA is a scheduling algorithm which ensures that cells are marked as conforming when they arrive when expected or later than expected and non-conforming when they arrive sooner than expected.

Generic Connection Admission Control (GCAC) - This is a process to determine if a link has potentially enough resources to support a connection.

Generic Flow Control (GFC) - the first four bits of the first byte in an ATM cell header. Used to control the flow of traffic across the User-to-Network Interface (UNI), and thus into the network. Exact mechanisms for flow control are still under investigation and no explicit definition for this field exists at this time. (This field is used only at the UNI; for NNI-NNI use (between network nodes), these four bits provide additional network address capacity, and are appended to the VPI field.)

GIO - a proprietary bus architecture used in certain Silicon Graphics, Inc. workstations.

Header - protocol control information located at the beginning of a protocol data unit.

Header Error Control (HEC) - a CRC code located in the last byte of an ATM cell header that is used for checking cell header integrity only.

High Density Bipolar (HDB3) - A bipolar coding method that does not allow more than 3 consecutive zeroes.

High Level Data Link Control (HDLC) - An ITU-TSS link layer protocol standard for point-to-point and multi-point communications.

High Performance Parallel Interface (HIPPI) - ANSI standard that extends the computer bus over fairly short distances at speeds of 800 and 1600 Mbps.

High-Speed Serial Interface (HSSI) - a serial communications connection that operates at speeds of up to 1.544 Mbps.

Host - In a network, the primary or controlling computer in a multiple computer installation.

HPUX - the Hewlett-Packard version of UNIX.

Hub - a device that connects several other devices, usually in a star topology.

I/O Module - FORE's interface cards for the LAX-20 LAN Access Switch, designed to connect Ethernet, Token Ring, and FDDI LANs to *ForeRunner* ATM networks.

Institute of Electrical and Electronics Engineers (IEEE) - the world's largest technical professional society. Based in the U.S., the IEEE sponsors technical conferences, symposia & local meetings worldwide, publishes nearly 25% of the world's technical papers in electrical, electronics & computer engineering, provides educational programs for members, and promotes standardization.

IEEE 802 - Standards for the interconnection of LAN computer equipment. Deals with the Data Link Layers of the ISO Reference Model for OSI.

IEEE 802.1 - Defines the high-level network interfaces such as architecture, internetworking and network management.

IEEE 802.2 - Defines the Logical Link Control interface between the Data Link and Network Layers.

IEEE 802.3 - Defines CSMA/CD (Ethernet).

IEEE 802.4 - Defines the token-passing bus.

IEEE 802.5 - Defines the Token Ring access methodology. This standard incorporates IBM's Token Ring specifications.

IEEE 802.6 - Defines Metropolitan Area Networks.

IEEE 802.7 - The broadband technical advisory group.

IEEE 802.8 - The fiber optics technical advisory group.

Integrated Services Digital Network (ISDN) - an emerging technology that is beginning to be offered by the telephone carriers of the world. ISDN combines voice and digital network services into a single medium or wire.

Interexchange Carriers (IXC) - Long-distance communications companies that provide service between Local Access Transport Areas (LATAs).

Interface Data - the unit of information transferred to/from the upper layer in a single interaction across a SAP. Each Interface Data Unit (IDU) controls interface information and may also contain the whole or part of the SDU.

Interface Data Unit (IDU) - The unit of information transferred to/from the upper layer in a single interaction across the SAP. Each IDU contains interface control information and may also contain the whole or part of the SDU.

Interim Local Management Interface (ILMI) - the standard that specifies the use of the Simple Network Management Protocol (SNMP) and an ATM management information base (MIB) to provide network status and configuration information.

Intermediate System (IS) - a system that provides forwarding functions or relaying functions or both for a specific ATM connection. OAM cells may be generated and received.

International Standards Organization (ISO) - a voluntary, non treaty organization founded in 1946 that is responsible for creating international standards in many areas, including computers and communications.

International Telephone and Telegraph Consultative Committee (CCITT) - the international standards body for telecommunications.

Internet - (note the capital "I") the largest internet in the world including large national backbone nets and many regional and local networks worldwide. The Internet uses the TCP/IP suite. Networks with only e-mail connectivity are not considered on the Internet.

internet - while an internet is a network, the term "internet" is usually used to refer to a collection of networks interconnected with routers.

Internet Addresses - the numbers used to identify hosts on an internet network. Internet host numbers are divided into two parts; the first is the network number and the second, or local, part is a host number on that particular network. There are also three classes of networks in the Internet, based on the number of hosts on a given network. Large networks are classified as Class A, having addresses in the range 1-126 and having a maximum of 16,387,064 hosts. Medium networks are classified as Class B, with addresses in the range 128-191 and with a maximum of 64,516 hosts. Small networks are classified as Class C, having addresses in the range 192-254 with a maximum of 254 hosts. Addresses are given as dotted decimal numbers in the following format:

nnn.nnn.nnn.nnn

In a Class A network, the first of the numbers is the network number, the last three numbers are the local host address.

In a Class B network, the first two numbers are the network, the last two are the local host address.

In a Class C network, the first three numbers are the network address, the last number is the local host address.

The following table summarizes the classes and sizes:

Class	First #	Max# Hosts
A	1-126	16,387,064
В	129-191	64,516
C	192-223	254

Glossary

Network mask values are used to identify the network portion and the host portion of the address. Default network masks are as follows:

Class A - 255.0.0.0

Class B - 255.255.0.0

Class C - 255,255,255.0

Subnet masking is used when a portion of the host ID is used to identify a subnetwork. For example, if a portion of a Class B network address is used for a subnetwork, the mask could be set as 255.255.255.0. This would allow the third byte to be used as a subnetwork address. All hosts on the network would still use the IP address to get on the Internet.

Internet Control Message Protocol (ICMP) - the protocol that handles errors and control messages at the IP layer. ICMP is actually a part of the IP protocol layer. It can generate error messages, test packets, and informational messages related to IP.

Internet Engineering Task Force (IETF) - a large, open, international community of network designers, operators, vendors and researchers whose purpose is to coordinate the operation, management and evolution of the Internet to resolve short- and mid-range protocol and architectural issues.

Internet Protocol (IP) - a connectionless, best-effort packet switching protocol that offers a common layer over dissimilar networks.

Internetwork Packet Exchange (IPX) Protocol - a NetWare protocol similar to the Xerox Network Systems (XNS) protocol that provides datagram delivery of messages.

Interoperability - The ability of software and hardware on multiple machines, from multiple vendors, to communicate.

Interworking Function (IWF) - provides a means for two different technologies to interoperate.

IP Address - a unique 32-bit integer used to identify a device in an IP network. You will most commonly see IP addresses written in "dot" notation (e.g., 192.228.32.14).

IP Netmask - a 32-bit pattern that is combined with an IP address to determine which bits of an IP address denote the network number and which denote the host number. Netmasks are useful for sub-dividing IP networks. IP netmasks are written in "dot" notation (e.g., 255.255.0.0).

ISA Bus - a bus standard developed by IBM for expansion cards in the first IBM PC. The original bus supported a data path only 8 bits wide. IBM subsequently developed a 16-bit version for its AT class computers. The 16-bit AT ISA bus supports both 8- and 16-bit cards. The 8-bit bus is commonly called the PC/XT bus, and the 16-bit bus is called the AT bus.

Isochronous - signals carrying embedded timing information or signals that are dependent on uniform timing; usually associated with voice and/or video transmission.

International Telecommunications Union Telecommunications (ITU-T) - an international body of member countries whose task is to define recommendations and standards relating to the international telecommunications industry. The fundamental standards for ATM have been defined and published by the ITU-T (Previously CCITT).

J2 - Wide-area digital transmission scheme used predominantly in Japan that carries data at a rate of 6.312 Mbps.

Jitter - analog communication line distortion caused by variations of a signal from its reference timing position.

Joint Photographic Experts Group (JPEG) - An ISO Standards group that defines how to compress still pictures.

Jumper - a patch cable or wire used to establish a circuit, often temporarily, for testing or diagnostics; also, the devices, shorting blocks, used to connect adjacent exposed pins on a printed circuit board that control the functionality of the card.

Kbps - kilobits per second (thousand)

LAN Access Concentrator - a LAN access device that allows a shared transmission medium to accommodate more data sources than there are channels currently available within the transmission medium.

LAN Emulation Address Resolution Protocol (LE_ARP) - A message issued by a LE client to solicit the ATM address of another function.

LAN Emulation Client (LEC) - the component in an end system that performs data forwarding, address resolution, and other control functions when communicating with other components within an ELAN.

LAN Emulation Configuration Server (LECS) - the LECS is responsible for the initial configuration of LECs. It provides information about available ELANs that a LEC may join, together with the addresses of the LES and BUS associated with each ELAN.

LAN Emulation Server (LES) - the LES implements the control coordination function for an ELAN by registering and resolving MAC addresses to ATM addresses.

LAN Emulation (LANE) - technology that allows an ATM network to function as a LAN backbone. The ATM network must provide multicast and broadcast support, address mapping (MAC-to-ATM), SVC management, and a usable packet format. LANE also defines Ethernet and Token Ring ELANs.

lane - a program that provides control over the execution of the LAN Emulation Server (LES), Broadcast/Unknown Server (BUS), and LAN Emulation Configuration Server (LECS) on the local host.

Latency - The time interval between a network station seeking access to a transmission channel and that access being granted or received.

Layer Entity - an active layer within an element.

Layer Function - a part of the activity of the layer entities.

Layer Service - a capability of a layer and the layers beneath it that is provided to the upper layer entities at the boundary between that layer and the next higher layer.

Layer User Data - the information transferred between corresponding entities on behalf of the upper layer or layer management entities for which they are providing services.

le - a FORE program that implements both the LAN Emulation Server (LES) and the Broadcast/Unknown Server (BUS).

Leaky Bucket - informal cell policing term for the Generic Cell Rate Algorithm which in effect receives cells into a bucket and leaks them out at the specified or contracted rate (i.e., PCR).

Least Significant Bit (LSB) - lowest order bit in the binary representation of a numerical value.

lecs - a FORE program that implements the assignment of individual LECs to different emulated LANs.

leq - a FORE program that provides information about an ELAN. This information is obtained from the LES, and includes MAC addresses registered on the ELAN together with their corresponding ATM addresses.

Line Build Out (LBO) - Because T1 circuits require the last span to lose 15-22.5 dB, a selectable output attenuation is generally required of DTE equipment (typical selections include 0.0, 7.5 and 15 dB of loss at 772 KHz).

Line Code Violations (LCV) - Error Event. A Line Coding Violation (LCV) is the occurrence of either a Bipolar Violation (BPV) or Excessive Zeroes (EXZ) Error Event.

Link - An entity that defines a topological relationship (including available transport capacity) between two nodes in different subnetworks. Multiple links may exist between a pair of subnetworks. Synonymous with logical link.

Link Access Procedure, Balanced (LAPB) - Data link protocol in the X.25 protocol stack. LAPB is a bit-oriented protocol derived from HDLC. See also HDLC and X.25.

Link Down Trap - an SNMP trap, sent when an interface changes from a normal state to an error state, or is disconnected.

Link Layer - layer in the OSI model regarding transmission of data between network nodes.

Link Up Trap - an SNMP trap, sent when an interface changes from an error condition to a normal state.

Load Sharing - Two or more computers in a system that share the load during peak hours. During periods of non peak hours, one computer can manage the entire load with the other acting as a backup.

Local Access and Transport Area (LATA) - Geographic boundaries of the local telephone network, specified by the FCC, in which a single LEC may perform its operations. Communications outside or between LATAs are provided by IXCs.

Local Area Network (LAN) - a data network intended to serve an area of only a few square kilometers or less. Because the network is known to cover only a small area, optimizations can be made in the network signal protocols that permit higher data rates.

Logical Link Control (LLC) - protocol developed by the IEEE 802 committee for data-link-layer transmission control; the upper sublayer of the IEEE Layer 2 (OSI) protocol that complements the MAC protocol; IEEE standard 802.2; includes end-system addressing and error checking.

Loopback - a troubleshooting technique that returns a transmitted signal to its source so that the signal can be analyzed for errors. Typically, a loopback is set at various points in a line until the section of the line that is causing the problem is discovered.

looptest - program that tests an interface for basic cell reception and transmission functionality, usually used for diagnostic purposes to determine if an interface is functioning properly.

Loss Of Frame (LOF) - a type of transmission error that may occur in wide-area carrier lines.

Loss Of Pointer (LOP) - a type of transmission error that may occur in wide-area carrier lines.

Loss Of Signal (LOS) - a type of transmission error that may occur in wide-area carrier lines, or a condition declared when the DTE senses a loss of a DS1 signal from the CPE for more the 150 milliseconds (the DTE generally responds with an all ones "Blue or AIS" signal).

Management Information Base (MIB) - the set of parameters that an SNMP management station can query or set in the SNMP agent of a networked device (e.g., router).

Maximum Burst Size (MBS) - the Burst Tolerance (BT) is conveyed through the MBS which is coded as a number of cells. The BT together with the SCR and the GCRA determine the MBS that may be transmitted at the peak rate and still be in conformance with the GCRA.

Maximum Burst Tolerance - the largest burst of data that a network device is guaranteed to handle without discarding cells or packets. Bursts of data larger than the maximum burst size may be subject to discard.

Maximum Cell Delay Variance (MCDV) - This is the maximum two-point CDV objective across a link or node for the specified service category.

Maximum Cell Loss Ratio (MCLR) - This is the maximum ratio of the number of cells that do not make it across the link or node to the total number of cells arriving at the link or node.

Maximum Cell Transfer Delay (MCTD) - This is the sum of the fixed delay component across the link or node and MCDV.

Maximum Transmission Unit (MTU) - the largest unit of data that can be sent over a type of physical medium.

Mbps - megabits per second (million)

Media Access Control (MAC) - a media-specific access control protocol within IEEE 802 specifications; currently includes variations for Token Ring, token bus, and CSMA/CD; the lower sublayer of the IEEE's link layer (OSI), which complements the Logical Link Control (LLC).

Media Attachment Unit (MAU) - device used in Ethernet and IEEE 802.3 networks that provides the interface between the AUI port of a station and the common medium of the Ethernet. The MAU, which can be built into a station or can be a separate device, performs physical layer functions including conversion of the digital data from the Ethernet interface, collision detection, and injection of bits onto the network.

Media Interface Connector (MIC) - fiber optic connector that joins fiber to the FDDI controller.

Message Identifier (MID) - message identifier used to associate ATM cells that carry segments from the same higher layer packet.

Metasignalling - an ATM Layer Management (LM) process that manages different types of signalling and possibly semipermanent virtual channels (VCs), including the assignment, removal, and checking of VCs.

Metasignalling VCs - the standardized VCs that convey metasignalling information across a User-to-Network Interface (UNI).

Metropolitan Area Network (MAN) - network designed to carry data over an area larger than a campus such as an entire city and its outlying area.

MicroChannel - a proprietary 16- or 32-bit bus developed by IBM for its PS/2 computers' internal expansion cards; also offered by others.

Minimum Cell Rate (MCR) - parameter defined by the ATM Forum for ATM traffic management, defined only for ABR transmissions and specifying the minimum value for the ACR.

Most Significant Bit (MSB) - highest order bit in the binary representation of a numerical value.

Motion Picture Experts Group (MPEG) - ISO group dealing with video and audio compression techniques and mechanisms for multiplexing and synchronizing various media streams.

MPOA Client - A device which implements the client side of one or more of the MPOA protocols, (i.e., is a SCP client and/or an RDP client. An MPOA Client is either an Edge Device Functional Group (EDFG) or a Host Behavior Functional Group (HBFG).

MPOA Server - An MPOA Server is any one of an ICFG or RSFG.

MPOA Service Area - The collection of server functions and their clients. A collection of physical devices consisting of an MPOA server plus the set of clients served by that server.

MPOA Target - A set of protocol address, path attributes, (e.g., internetwork layer QoS, other information derivable from received packet) describing the intended destination and its path attributes that MPOA devices may use as lookup keys.

Mu-Law - The PCM coding and companding standard used in Japan and North America.

Multicasting - The ability to broadcast messages to one node or a select group of nodes.

Multi-homed - a device having both an ATM and another network connection, like Ethernet.

Multimode Fiber Optic Cable (MMF) - fiber optic cable in which the signal or light propagates in multiple modes or paths. Since these paths may have varying lengths, a transmitted pulse of light may be received at different times and smeared to the point that pulses may interfere with surrounding pulses. This may cause the signal to be difficult or impossible to receive. This pulse dispersion sometimes limits the distance over which a MMF link can operate.

Multiplexing - a function within a layer that interleaves the information from multiple connections into one connection (see demultiplexing).

Multipoint Access - user access in which more than one terminal equipment (TE) is supported by a single network termination.

Multipoint-to-Multipoint Connection - a collection of associated ATM VC or VP links, and their associated endpoint nodes, with the following properties:

- 1. All N nodes in the connection, called Endpoints, serve as a Root Node in a Point-to-Multipoint connection to all of the (N-1) remaining endpoints.
- 2. Each of the endpoints can send information directly to any other endpoint, but the receiving endpoint cannot distinguish which of the endpoints is sending information without additional (e.g., higher layer) information.

Multipoint-to-Point Connection - a Point-to-Multipoint Connection may have zero bandwidth from the Root Node to the Leaf Nodes, and non-zero return bandwidth from the Leaf Nodes to the Root Node. Such a connection is also known as a Multipoint-to-Point Connection.

Multiprotocol over ATM (MPOA) - An effort taking place in the ATM Forum to standardize protocols for the purpose of running multiple network layer protocols over ATM.

Narrowband Channel - sub-voicegrade channel with a speed range of 100 to 200 bps.

National TV Standards Committee (NTSC) - Started in the US in 1953 from a specification laid down by the National Television Standards Committee. It takes the B-Y and R-Y color difference signals, attenuates them to I and Q, then modulates them using double-sideband suppressed subcarrier at 3.58MHz. The carrier reference is sent to the receiver as a burst during the back porch. An industry group that defines how television signals are encoded and transmitted in the US. (See also PAL, SECAM for non-U.S. countries).

Near-End - in a relationship between two devices in a circuit, the near-end device is the one that is local.

Network Layer - Layer three In the OSI model, the layer that is responsible for routing data across the network.

Network Management Entity (NM) - body of software in a switching system that provides the ability to manage the PNNI protocol. NM interacts with the PNNI protocol through the MIB.

Network Management Layer (NML) - an abstraction of the functions provided by systems which manage network elements on a collective basis, providing end-to-end network monitoring.

Network Management Station (NMS) - system responsible for managing a network or portion of a network by talking to network management agents, which reside in the managed nodes.

Network Module - ATM port interface cards which may be individually added to or removed from any *ForeRunner* ATM switch to provide a diverse choice of connection alternatives.

Network Parameter Control (NPC) - Defined as the set of actions taken by the network to monitor and control traffic from the NNI. Its main purpose is to protect network resources from malicious as well as unintentional misbehavior which can affect the QoS of other already established connections by detecting violations of negotiated parameters and taking appropriate actions. Refer to UPC.

Network Redundancy - Duplicated network equipment and/or data which can provide a backup in case of network failures.

Network Service Access Point (NSAP) - OSI generic standard for a network address consisting of 20 octets. ATM has specified E.164 for public network addressing and the NSAP address structure for private network addresses.

Network-to-Network Interface or Network Node Interface (NNI) - the interface between two public network pieces of equipment.

Node - A computer or other device when considered as part of a network.

Non Return to Zero (NRZ) - a binary encoding scheme in which ones and zeroes are represented by opposite and alternating high and low voltages and where there is no return to a zero (reference) voltage between encoded bits.

Non Return to Zero Inverted (NRZI) - A binary encoding scheme that inverts the signal on a "1" and leaves the signal unchanged for a "0". (Also called transition encoding.)

Nonvolatile Storage - Memory storage that does not lose its contents when power is turned off.

NuBus - a high-speed bus used in Macintosh computers, structured so users can put a card into any slot on the board without creating conflict over the priority between those cards.

nx64K - This refers to a circuit bandwidth or speed provided by the aggregation of nx64 kbps channels (where n= integer > 1). The 64K or DS0 channel is the basic rate provided by the T Carrier systems.

Nyquist Theorem - In communications theory, a formula stating that two samples per cycle is sufficient to characterize a bandwidth limited analog signal; in other words, the sampling rate must be twice the highest frequency component of the signal (i.e., sample 4 KHz analog voice channels 8000 times per second).

Object Identifier (OID) - the address of a MIB variable.

Octet - a grouping of 8 bits; similar, but not identical to, a byte.

One's Density - The requirement for digital transmission lines in the public switched telephone network that eight consecutive "0"s cannot be in a digital data stream; exists because repeaters and clocking devices within the network will lose timing after receiving eight "0"s in a row; a number of techniques are used to insert a "1" after every seventh-consecutive "0" (see Bit Stuffing).

Open Shortest Path First (OSPF) Protocol - a routing algorithm for IP that incorporates least-cost, equal-cost, and load balancing.

Open Systems Interconnection (OSI) - the 7-layer suite of protocols designed by ISO committees to be the international standard computer network architecture.

OpenView - Hewlett-Packard's network management software.

Operation and Maintenance (OAM) Cell - a cell that contains ATM LM information. It does not form part of the upper layer information transfer.

Optical Carrier level-n (OC-n) - The optical counterpart of STS-n (the basic rate of 51.84 Mbps on which SONET is based is referred to as OC-1 or STS-1).

Organizationally Unique Identifier (OUI) - Part of RFC 1483. A three-octet field in the SubNetwork Attachment Point (SNAP) header, identifying an organization which administers the meaning of the following two octet Protocol Identifier (PID) field in the SNAP header. Together they identify a distinct routed or bridged protocol.

Out-of-Band Management - refers to switch configuration via the serial port or over Ethernet, not ATM.

Out-of-Frame (OOF) - a signal condition and alarm in which some or all framing bits are lost.

Packet - An arbitrary collection of data grouped and transmitted with its user identification over a shared facility.

Packet Assembler Disassembler (PAD) - interface device that buffers data sent to/from character mode devices, and assembles and disassembles the packets needed for X.25 operation.

Packet Internet Groper (ping) - a program used to test reachability of destinations by sending them an ICMP echo request and waiting for a reply.

Packet Level Protocol (PLP) - Network layer protocol in the X.25 protocol stack. Sometimes called X.25 Level 3 or X.25 Protocol.

Packet Switched Network (PSN) - a network designed to carry data in the form of packets. The packet and its format is internal to that network.

Packet Switching - a communications paradigm in which packets (messages) are individually routed between hosts with no previously established communications path.

Payload Scrambling - a technique that eliminates certain bit patterns that may occur within an ATM cell payload that could be misinterpreted by certain sensitive transmission equipment as an alarm condition.

Payload Type (PT) - bits 2...4 in the fourth byte of an ATM cell header. The PT indicates the type of information carried by the cell. At this time, values 0...3 are used to identify various types of user data, values 4 and 5 indicate management information, and values 6 and 7 are reserved for future use.

Peak Cell Rate - at the PHY Layer SAP of a point-to-point VCC, the Peak Cell Rate is the inverse of the minimum inter-arrival time T0 of the request to send an ATM-SDU.

Peak Cell Rate (PCR) - parameter defined by the ATM Forum for ATM traffic management. In CBR transmissions, PCR determines how often data samples are sent. In ABR transmissions, PCR determines the maximum value of the ACR.

Peer Entities - entities within the same layer.

Peripheral Component Interconnect (PCI) - a local-bus standard created by Intel.

Permanent Virtual Channel Connection (PVCC) - A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell. A Permanent VCC is one which is provisioned through some network management function and left up indefinitely.

Permanent Virtual Circuit (or Channel) (PVC) - a circuit or channel through an ATM network provisioned by a carrier between two endpoints; used for dedicated long-term information transport between locations.

Permanent Virtual Path Connection (PVPC) - A Virtual Path Connection (VPC) is an ATM connection where switching is performed on the VPI field only of each cell. A PVPC is one which is provisioned through some network management function and left up indefinitely.

Phase Alternate Line (PAL) - Largely a German/British development in the late 60s, used in the UK and much of Europe. The B-Y and R-Y signals are weighted to U and V, then modulated onto a double-sideband suppressed subcarrier at 4.43MHz. The V (R-Y) signal's phase is turned through 180 degrees on each alternate line. This gets rid of NTSC's hue changes with phase errors at the expense of de-saturation. The carrier reference is sent as a burst in the back porch. The phase of the burst is alternated every line to convey the phase switching of the V signal. The burst's average phase is -V. (see NTSC for U.S.).

Physical Layer (PHY) - the actual cards, wires, and/or fiber-optic cabling used to connect computers, routers, and switches.

Physical Layer Connection - an association established by the PHY between two or more ATM-entities. A PHY connection consists of the concatenation of PHY links in order to provide an end-to-end transfer capability to PHY SAPs.

Physical Layer Convergence Protocol (PLCP) - a framing protocol that runs on top of the T1 or E1 framing protocol.

Physical Medium (PM) - Refers to the actual physical interfaces. Several interfaces are defined including STS-1, STS-3c, STS-12c, STM-1, STM-4, DS1, E1, DS2, E3, DS3, E4, FDDI-based, Fiber Channel-based, and STP. These range in speeds from 1.544Mbps through 622.08 Mbps.

Physical Medium Dependent (PMD) - a sublayer concerned with the bit transfer between two network nodes. It deals with wave shapes, timing recovery, line coding, and electro-optic conversions for fiber based links.

Plesiochronous - two signals are plesiochronous if their corresponding significant instants occur at nominally the same rate, with variations in rate constrained to specified limits.

Point of Demarcation - the dividing line between a carrier and the customer premise that is governed by strict standards that define the characteristics of the equipment on each side of the demarcation. Equipment on one side of the point of demarcation is the responsibility of the customer. Equipment on the other side of the point of demarcation is the responsibility of the carrier.

Point-to-Multipoint Connection - a collection of associated ATM VC or VP links, with associated endpoint nodes, with the following properties:

- 1. One ATM link, called the Root Link, serves as the root in a simple tree topology. When the Root node sends information, all of the remaining nodes on the connection, called Leaf nodes, receive copies of the information.
- 2. Each of the Leaf Nodes on the connection can send information directly to the Root Node. The Root Node cannot distinguish which Leaf is sending information without additional (higher layer) information. (See the following note for Phase 1.)
- 3. The Leaf Nodes cannot communicate directly to each other with this connection type.

Note: Phase 1 signalling does not support traffic sent from a Leaf to the Root.

Point-to-Point Connection - a connection with only two endpoints.

Point-to-Point Protocol (PPP) - Provides a method for transmitting packets over serial point-to-point links.

Policing - the function that ensures that a network device does not accept traffic that exceeds the configured bandwidth of a connection.

Port Identifier - The identifier assigned by a logical node to represent the point of attachment of a link to that node.

Presentation Layer - Sixth layer of the OSI model, providing services to the application layer.

Primary Reference Source (PRS) - Equipment that provides a timing signal whose long-term accuracy is maintained at 1×10 -11 or better with verification to universal coordinated time (UTC) and whose timing signal is used as the basis of reference for the control of other clocks within a network.

Primitive - an abstract, implementation-independent interaction between a layer service user and a layer service provider.

Priority - the parameter of ATM connections that determines the order in which they are reduced from the peak cell rate to the sustained cell rate in times of congestion. Connections with lower priority (4 is low, 1 is high) are reduced first.

Private Branch Exchange (PBX) - a private phone system (switch) that connects to the public telephone network and offers in-house connectivity. To reach an outside line, the user must dial a digit like 8 or 9.

Private Network Node Interface or Private Network-to-Network Interface (PNNI) - a protocol that defines the interaction of private ATM switches or groups of private ATM switches

Programmable Read-Only Memory (PROM) - a chip-based information storage area that can be recorded by an operator but erased only through a physical process.

Protocol - a set of rules and formats (semantic and syntactic) that determines the communication behavior of layer entities in the performance of the layer functions.

Protocol Control Information - the information exchanged between corresponding entities using a lower layer connection to coordinate their joint operation.

Protocol Data Unit (PDU) - a unit of data specified in a layer protocol and consisting of protocol control information and layer user data.

Proxy - the process in which one system acts for another system to answer protocol requests.

Proxy Agent - an agent that queries on behalf of the manager, used to monitor objects that are not directly manageable.

Public Data Network (PDN) - a network designed primarily for data transmission and intended for sharing by many users from many organizations.

Pulse Code Modulation (PCM) - a modulation scheme that samples the information signals and transmits a series of coded pulses to represent the data.

Q.2931 - Derived from Q.93B, the narrowband ISDN signalling protocol, an ITU standard describing the signalling protocol to be used by switched virtual circuits on ATM LANs.

Quality of Service (QoS) - Quality of Service is defined on an end-to-end basis in terms of the following attributes of the end-to-end ATM connection:

Cell Loss Ratio

Cell Transfer Delay

Cell Delay Variation

Queuing Delay (QD) - refers to the delay imposed on a cell by its having to be buffered because of unavailability of resources to pass the cell onto the next network function or element. This buffering could be a result of oversubscription of a physical link, or due to a connection of higher priority or tighter service constraints getting the resource of the physical link.

Radio Frequency Interference (RFI) - the unintentional transmission of radio signals. Computer equipment and wiring can both generate and receive RFI.

Real-Time Clock - a clock that maintains the time of day, in contrast to a clock that is used to time the electrical pulses on a circuit.

Red Alarm - In T1, a red alarm is generated for a locally detected failure such as when a condition like OOF exists for 2.5 seconds, causing a CGA, (Carrier Group Alarm).

Reduced Instruction Set Computer (RISC) - a generic name for CPUs that use a simpler instruction set than more traditional designs.

Redundancy - In a data transmission, the fragments of characters and bits that can be eliminated with no loss of information.

Registration - The address registration function is the mechanism by which Clients provide address information to the LAN Emulation Server.

Relaying - a function of a layer by means of which a layer entity receives data from a corresponding entity and transmits it to another corresponding entity.

Request To Send (RTS) - an RS-232 modem interface signal (sent from the DTE to the modem on pin 4) which indicates that the DTE has data to transmit.

Requests For Comment (RFCs) - IETF documents suggesting protocols and policies of the Internet, inviting comments as to the quality and validity of those policies. These comments are collected and analyzed by the IETF in order to finalize Internet standards.

RFC1483 - Multiprotocol Encapsulation over ATM Adaptation Layer 5.

RFC1490 - Multiprotocol Interconnect over Frame Relay.

RFC1577 - Classical IP and ARP over ATM.

RFC1755 - ATM Signaling Support for IP over ATM.

Robbed-Bit Signaling - In T1, refers to the use of the least significant bit of every word of frames 6 and 12 (D4), or 6, 12, 18, and 24 (ESF) for signaling purposes.

Route Server - A physical device that runs one or more network layer routing protocols, and which uses a route query protocol in order to provide network layer routing forwarding descriptions to clients.

Router - a device that forwards traffic between networks or subnetworks based on network layer information.

Routing Domain (RD) - A group of topologically contiguous systems which are running one instance of routing.

Routing Information Protocol (RIP) - a distance vector-based protocol that provides a measure of distance, or hops, from a transmitting workstation to a receiving workstation.

Routing Protocol - A general term indicating a protocol run between routers and/or route servers in order to exchange information used to allow computation of routes. The result of the routing computation will be one or more forwarding descriptions.

SBus - hardware interface for add-in boards in later-version Sun 3 workstations.

Scalable Processor Architecture Reduced instruction set Computer (SPARC) - a powerful workstation similar to a reduced-instruction-set-computing (RISC) workstation.

Segment - a single ATM link or group of interconnected ATM links of an ATM connection.

Segmentation And Reassembly (SAR) - the SAR accepts PDUs from the CS and divides them into very small segments (44 bytes long). If the CS-PDU is less than 44 bytes, it is padded to 44 with zeroes. A two-byte header and trailer are added to this basic segment. The header identifies the message type (beginning, end, continuation, or single) and contains sequence numbering and message identification. The trailer gives the SAR-PDU payload length, exclusive of pad, and contains a CRC check to ensure the SAR-PDU integrity. The result is a 48-byte PDU that fits into the payload field of an ATM cell.

Selector (SEL) - A subfield carried in SETUP message part of ATM endpoint address Domain specific Part (DSP) defined by ISO 10589, not used for ATM network routing, used by ATM end systems only.

Semipermanent Connection - a connection established via a service order or via network management.

Serial Line IP (SLIP) - A protocol used to run IP over serial lines, such as telephone circuits or RS-232 cables, interconnecting two systems.

Service Access Point (SAP) - the point at which an entity of a layer provides services to its LM entity or to an entity of the next higher layer.

Service Data Unit (SDU) - a unit of interface information whose identity is preserved from one end of a layer connection to the other.

Service Specific Connection Oriented Protocol (SSCOP) - an adaptation layer protocol defined in ITU-T Specification: Q.2110.

Service Specific Convergence Sublayer (SSCS) - The portion of the convergence sublayer that is dependent upon the type of traffic that is being converted.

Session Layer - Layer 5 in the OSI model that is responsible for establishing and managing sessions between the application programs running in different nodes.

Severely Errored Seconds (SES) - a second during which more event errors have occurred than the SES threshold (normally 10-3).

Shaping Descriptor - *n* ordered pairs of GCRA parameters (I,L) used to define the negotiated traffic shape of an APP connection. The traffic shape refers to the load-balancing of a network, where load-balancing means configuring data flows to maximize network efficiency.

Shielded Pair - Two insulated wires in a cable wrapped with metallic braid or foil to prevent interference and provide noise free transmission.

Shielded Twisted Pair (STP) - two or more insulated wires, twisted together and then wrapped in a cable with metallic braid or foil to prevent interference and offer noise-free transmissions.

Signaling System No. 7 (SS7) - The SS7 protocol has been specified by ITU-T and is a protocol for interexchange signaling.

Simple and Efficient Adaptation Layer (SEAL) - also called AAL 5, this ATM adaptation layer assumes that higher layer processes will provide error recovery, thereby simplifying the SAR portion of the adaptation layer. Using this AAL type packs all 48 bytes of an ATM cell information field with data. It also assumes that only one message is crossing the UNI at a time. That is, multiple end-users at one location cannot interleave messages on the same VC, but must queue them for sequential transmission.

Simple Gateway Management Protocol (SGMP) - the predecessor to SNMP.

Simple Mail Transfer Protocol (SMTP) - the Internet electronic mail protocol used to transfer electronic mail between hosts.

Simple Network Management Protocol (SNMP) - the Internet standard protocol for managing nodes on an IP network.

Simple Protocol for ATM Network Signalling (SPANS) - FORE Systems' proprietary signalling protocol used for establishing SVCs between FORE Systems equipment.

Single Mode Fiber (SMF) - Fiber optic cable in which the signal or light propagates in a single mode or path. Since all light follows the same path or travels the same distance, a transmitted pulse is not dispersed and does not interfere with adjacent pulses. SMF fibers can support longer distances and are limited mainly by the amount of attenuation. Refer to MMF.

Small Computer Systems Interface (SCSI) - a standard for a controller bus that connects hardware devices to their controllers on a computer bus, typically used in small systems.

Smart PVC (SPVC) - a generic term for any communications medium which is permanently provisioned at the end points, but switched in the middle. In ATM, there are two kinds of SPVCs: smart permanent virtual path connections (SPVPCs) and smart permanent virtual channel connections (SPVCCs).

snmpd - an SMNP agent for a given adapter card.

Source - Part of communications system which transmits information.

Source Address (SA) - The address from which the message or data originated.

Source MAC Address (SA) - A six octet value uniquely identifying an end point and which is sent in an IEEE LAN frame header to indicate source of frame.

Source Traffic Descriptor - a set of traffic parameters belonging to the ATM Traffic Descriptor used during the connection set-up to capture the intrinsic traffic characteristics of the connection requested by the source.

Spanning Tree Protocol - provides loop-free topology in a network environment where there are redundant paths.

Static Route - a route that is entered manually into the routing table.

Statistical Multiplexing - a technique for allowing multiple channels and paths to share the same link, typified by the ability to give the bandwidth of a temporarily idle channel to another channel.

Stick and Click (SC) - Designation for an Optical Connector featuring a 2.5 mm physically contacting ferrule with a push-pull mating design. Commonly referred to as Structured Cabling, Structured Connectors or Stick and Click

Stick and Turn (ST) - A fiber-optic connector designed by AT&T which uses the bayonet style coupling rather than screw-on as the SMA uses. The ST is generally considered the eventual replacement for the SMA type connector.

Store-and-Forward - the technique of receiving a message, storing it until the proper outgoing line is available, then retransmitting it, with no direct connection between incoming and outgoing lines.

Straight Tip (ST) - see Stick and Turn.

Structured Cabling (SC) - see Stick and Click.

Structured Connectors (SC) - see Stick and Click.

Sublayer - a logical subdivision of a layer.

SubNetwork Access Protocol (SNAP) - a specially reserved variant of IEEE 802.2 encoding SNAP indicates to look further into the packet where it will fine a Type field.

Subscriber Network Interface (SNI) - the interface between an SMDS end user's CPE and the network directly serving the end user, supported by either a DS1 or DS3 access arrangement.

Super Frame (SF) - a term used to describe the repeating 12 D4 frame format that composes a standard (non-ESF) T1 service.

Super User - a login ID that allows unlimited access to the full range of a device's functionality, including especially the ability to reconfigure the device and set passwords.

Sustainable Cell Rate (SCR) - ATM Forum parameter defined for traffic management. For VBR connections, SCR determines the long-term average cell rate that can be transmitted.

Sustained Information Rate (SIR) - In ATM this refers to the long-term average data transmission rate across the User-to-Network Interface. In SMDS this refers to the committed information rate (similar to CIR for Frame Relay Service).

Switch - Equipment used to interconnect lines and trunks.

Switched Connection - A connection established via signaling.

Switched Multimegabit Data Service (SMDS) - a high-speed, datagram-based, public data network service expected to be widely used by telephone companies in their data networks.

Switched Virtual Channel Connection (SVCC) - A Switched VCC is one which is established and taken down dynamically through control signaling. A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell.

Switched Virtual Circuit (or Channel) (SVC) - a channel established on demand by network signalling, used for information transport between two locations and lasting only for the duration of the transfer; the datacom equivalent of a dialed telephone call.

Switched Virtual Path Connection (SVPC) - a connection which is established and taken down dynamically through control signaling. A Virtual Path Connection (VPC) is an ATM connection where switching is performed on the VPI field only of each cell.

Switching System - A set of one or more systems that act together and appear as a single switch for the purposes of PNNI routing.

 $\textbf{Symmetric Connection -} a \ connection \ with \ the \ same \ bandwidth \ specified \ for \ both \ directions.$

Synchronous - signals that are sourced from the same timing reference and hence are identical in frequency.

Synchronous Data Link Control (SDLC) - IBM's data link protocol used in SNA networks.

Synchronous Optical Network (SONET) - a body of standards that defines all aspects of transporting and managing digital traffic over optical facilities in the public network.

Synchronous Payload Envelope (SPE) - the payload field plus a little overhead of a basic SONET signal.

Synchronous Transfer Mode (STM) - a transport and switching method that depends on information occurring in regular, fixed patterns with respect to a reference such as a frame pattern.

Synchronous Transport Signal (STS) - a SONET electrical signal rate.

Systeme En Coleur Avec Memoire (SECAM) - Sequential and Memory Color Television - Started in France in the late 60s, and used by other countries with a political affiliation. This is. The B-Y and R-Y signals are transmitted on alternate lines modulated on an FM subcarrier. The memory is a one line delay line in the receiver to make both color difference signals available at the same time on all lines. Due to FM, the signal is robust in difficult terrain.

Systems Network Architecture (SNA) - a proprietary networking architecture used by IBM and IBM-compatible mainframe computers.

T1 - a specification for a transmission line. The specification details the input and output characteristics and the bandwidth. T1 lines run at 1.544 Mbps and provide for 24 data channels. In common usage, the term "T1" is used interchangeably with "DS1."

T1 Link - A wideband digital carrier facility used for transmission of digitized voice, digital data, and digitized image traffic. This link is composed of two twisted-wire pairs that can carry 24 digital channels, each operating at 64K bps at the aggregate rate of 1.544M bps, full duplex. Also referred to as DS-1.

T3 - a specification for a transmission line, the equivalent of 28 T1 lines. T3 lines run at 44.736 Mbps. In common usage, the term "T3" is used interchangeably with "DS3."

Tachometer - in *ForeView*, the tachometer shows the level of activity on a given port. The number in the tachometer shows the value of a chosen parameter in percentage, with a colored bar providing a semi-logarithmic representation of that percentage.

Tagged Cell Rate (TCR) - An ABR service parameter, TCR limits the rate at which a source may send out-of-rate forward RM-cells. TCR is a constant fixed at 10 cells/second.

Telephony - The conversion of voices and other sounds into electrical signals which are then transmitted by telecommunications media.

Telnet - a TCP/IP protocol that defines a client/server mechanism for emulating directly-connected terminal connections.

Terminal Equipment (TE) - Terminal equipment represents the endpoint of ATM connection(s) and termination of the various protocols within the connection(s).

Throughput - Measurement of the total useful information processed or communicated by a computer during a specified time period, i.e. packets per second.

Time Division Multiplexing (TDM) - a method of traditional digital multiplexing in which a signal occupies a fixed, repetitive time slot within a higher-rate signal.

Token Ring - a network access method in which the stations circulate a token. Stations with data to send must have the token to transmit their data.

topology - a program that displays the topology of a FORE Systems ATM network. An updated topology can be periodically re-displayed by use of the interval command option.

Traffic - the calls being sent and received over a communications network. Also, the packets that are sent on a data network.

Traffic Management (TM) - The traffic control and congestion control procedures for ATM. ATM layer traffic control refers to the set of actions taken by the network to avoid congestion conditions. ATM layer congestion control refers to the set of actions taken by the network to minimize the intensity, spread and duration of congestion. The following functions form a framework for managing and controlling traffic and congestion in ATM networks and may be used in appropriate combinations:

Connection Admission Control Feedback Control Usage Parameter Control Priority Control Traffic Shaping Network Resource Management Frame Discard ABR Flow Control

Traffic Parameter - A parameter for specifying a particular traffic aspect of a connection.

Trailer - the protocol control information located at the end of a PDU.

Transit Delay - the time difference between the instant at which the first bit of a PDU crosses one designated boundary, and the instant at which the last bit of the same PDU crosses a second designated boundary.

Transmission Control Protocol (TCP) - a specification for software that bundles and unbundles sent and received data into packets, manages the transmission of packets on a network, and checks for errors.

Transmission Control Protocol/Internet Protocol (TCP/IP) - a set of communications protocols that has evolved since the late 1970s, when it was first developed by the Department of Defense. Because programs supporting these protocols are available on so many different computer systems, they have become an excellent way to connect different types of computers over networks.

Transmission Convergence (TC) - generates and receives transmission frames and is responsible for all overhead associated with the transmission frame. The TC sublayer packages cells into the transmission frame.

Transmission Convergence Sublayer (TCS) - This is part of the ATM physical layer that defines how cells will be transmitted by the actual physical layer.

Transparent Asynchronous Transmitter/Receiver Interface (TAXI) - Encoding scheme used for FDDI LANs as well as for ATM; supports speed typical of 100 Mbps over multimode fiber.

Transport Layer - Layer Four of the OSI reference model that is responsible for maintaining reliable end-to-end communications across the network.

trap - a program interrupt mechanism that automatically updates the state of the network to remote network management hosts. The SNMP agent on the switch supports these SNMP traps.

Trivial File Transfer Protocol (TFTP) - Part of IP, a simplified version of FTP that allows files to be transferred from one computer to another over a network.

Twisted Pair - Insulated wire in which pairs are twisted together. Commonly used for telephone connections, and LANs because it is inexpensive.

Unassigned Cells - a generated cell identified by a standardized virtual path identifier (VPI) and virtual channel identifier (VCI) value, which does not carry information from an application using the ATM Layer service.

Unavailable Seconds (UAS) - a measurement of signal quality. Unavailable seconds start accruing when ten consecutive severely errored seconds occur.

UNI 3.0/3.1 - the User-to-Network Interface standard set forth by the ATM Forum that defines how private customer premise equipment interacts with private ATM switches.

Unicasting - The transmit operation of a single PDU by a source interface where the PDU reaches a single destination.

Universal Test & Operations Interface for ATM (UTOPIA) - Refers to an electrical interface between the TC and PMD sublayers of the PHY layer.

Unshielded Twisted Pair (UTP) - a cable that consists of two or more insulated conductors in which each pair of conductors are twisted around each other. There is no external protection and noise resistance comes solely from the twists.

Unspecified Bit Rate (UBR) - a type of traffic that is not considered time-critical (e.g., ARP messages, pure data), allocated whatever bandwidth is available at any given time. UBR traffic is given a "best effort" priority in an ATM network with no guarantee of successful transmission.

Uplink - Represents the connectivity from a border node to an upnode.

Usage Parameter Control (UPC) - mechanism that ensures that traffic on a given connection does not exceed the contracted bandwidth of the connection, responsible for policing or enforcement. UPC is sometimes confused with congestion management (see *congestion management*).

User Datagram Protocol (UDP) - the TCP/IP transaction protocol used for applications such as remote network management and name-service access; this lets users assign a name, such as "RVAX*2,S," to a physical or numbered address.

User-to-Network Interface (UNI) - the physical and electrical demarcation point between the user and the public network service provider.

V.35 - ITU-T standard describing a synchronous, physical layer protocol used for communications between a network access device and a packet network. V.35 is most commonly used in the United States and Europe, and is recommended for speeds up to 48 Kbps.

Variable Bit Rate (VBR) - a type of traffic that, when sent over a network, is tolerant of delays and changes in the amount of bandwidth it is allocated (e.g., data applications).

Virtual Channel (or Circuit) (VC) - a communications path between two nodes identified by label rather than fixed physical path.

Virtual Channel Connection (VCC) - a unidirectional concatenation of VCLs that extends between the points where the ATM service users access the ATM Layer. The points at which the ATM cell payload is passed to, or received from, the users of the ATM Layer (i.e., a higher layer or ATMM-entity) for processing signify the endpoints of a VCC.

Virtual Channel Identifier (VCI) - the address or label of a VC; a value stored in a field in the ATM cell header that identifies an individual virtual channel to which the cell belongs. VCI values may be different for each data link hop of an ATM virtual connection.

Virtual Channel Link (VCL) - a means of unidirectional transport of ATM cells between the point where a VCI value is assigned and the point where that value is translated or removed.

Virtual Channel Switch - a network element that connects VCLs. It terminates VPCs and translates VCI values. The Virtual Channel Switch is directed by Control Plane functions and relays the cells of a VC.

Virtual Connection - an endpoint-to-endpoint connection in an ATM network. A virtual connection can be either a virtual path or a virtual channel.

Virtual Local Area Network (VLAN) - Work stations connected to an intelligent device which provides the capabilities to define LAN membership.

Virtual Network Software (VINES) - Banyan's network operating system based on UNIX and its protocols.

Virtual Path (VP) - a unidirectional logical association or bundle of VCs.

Virtual Path Connection (VPC) - a concatenation of VPLs between virtual path terminators (VPTs). VPCs are unidirectional.

Virtual Path Identifier (VPI) - the address or label of a particular VP; a value stored in a field in the ATM cell header that identifies an individual virtual path to which the cell belongs. A virtual path may comprise multiple virtual channels.

Virtual Path Link (VPL) - a means of unidirectional transport of ATM cells between the point where a VPI value is assigned and the point where that value is translated or removed.

Virtual Path Switch - a network element that connects VPLs, it translates VPI (not VCI) values and is directed by Control Plane functions. The Virtual Path Switch relays the cells of a Virtual Path.

Virtual Path Terminator (VPT) - a system that unbundles the VCs of a VP for independent processing of each VC.

Virtual Private Data Network (VPDN) - a private data communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

Virtual Private Network (VPN) - a private voice communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

Virtual Source/Virtual Destination (VS/VD) - An ABR connection may be divided into two or more separately controlled ABR segments. Each ABR control segment, except the first, is sourced by a virtual source. A virtual source implements the behavior of an ABR source endpoint. Backwards RM-cells received by a virtual source are removed from the connection. Each ABR control segment, except the last, is terminated by a virtual destination. A virtual destination assumes the behavior of an ABR destination endpoint. Forward RM-cells received by a virtual destination are turned around and not forwarded to the next segment of the connection.

Virtual Tributary (VT) - a structure used to carry payloads such as DS1s that run at significantly lower rates than STS-1s.

Warm Start Trap - an SNMP trap which indicates that SNMP alarm messages or agents have been enabled.

Wide-Area Network (WAN) - a network that covers a large geographic area.

Wideband Channel - Communications channel with more capacity (19.2K bps) than the standard capacity of a voice grade line.

X.21 - ITU-T standard for serial communications over synchronous digital lines. The X.21 protocol is used primarily in Europe and Japan.

X.25 - a well-established data switching and transport method that relies on a significant amount of processing to ensure reliable transport over metallic media.

Yellow Alarm - An alarm signal sent back toward the source of a failed signal due to the presence of an AIS (may be used by APS equipment to initiate switching).

Zero Byte Time Slot Interchange (ZBTSI) - A technique used with the T carrier extended superframe format (ESF) in which an area in the ESF frame carries information about the location of all-zero bytes (eight consecutive "0"s) within the data stream.

Zero Code Suppression - The insertion of a "1" bit to prevent the transmission of eight or more consecutive "0" bits. Used primarily with T1 and related digital telephone company facilities, which require a minimum "1's density" in order to keep the individual subchannels of a multiplexed, high speed facility active.

Zero-Bit Insertion - A technique used to achieve transparency in bit-oriented protocols. A zero is inserted into sequences of one bits that cause false flag direction.

Glossary

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